TALENT IN DRAWING

An Experimental Study of the Use of Tests to Discover Special Ability

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PREFACE

In the summer of 1916, the General Education Board made an appropriation for a study of gifted children. The investigation has been carried forward under the direction of Professor G. M. Whipple of the University of Illinois. During the present school year (1916-17), three persons have worked on the problem under Professor Whipple's supervision: Miss Genevieve L. Coy, Dr. T. S. Henry, and the author. Miss Coy has spent a large part of the school year in a study of gifted children, and other children with whom the gifted children might be compared, in the fifth and sixth grades of the Leal School, Urbana, Illinois. Dr. Henry has investigated the class-room instruction of gifted children. The author undertook an investigation of specialized ability, and further limited his research to a study of talent in one direction, viz., drawing. It is the purpose of this volume to present an account of the research undertaken by the author.

For assistance in this research I am indebted to Professor G. M. Whipple, Professor W. C. Bagley, and Professor C. H. Johnston of the Department of Education of the University of Illinois; to Professor E. J. Lake of the Department of Art and Design of the University of Illinois; to my colleagues Miss Genevieve L. Coy and Dr. T. S. Henry; to Superintendent W. W. Earnest of the Champaign Public Schools; to Miss Lottie Switzer, Principal, Miss Mary Hill, Supervisor of Art, and various teachers of the Champaign High School; to Superintendent A. P. Johnson of the Urbana Public Schools; to Mr. M. L. Flaningam, Principal of the Urbana High

School; to Mr. L. C. Griggs, Principal of the Leal School, Urbana; to Miss Alice Frazey, Supervisor of Art, Miss Burdelle Ealey, Teacher of Art, and to various teachers of the Urbana Public Schools; to Mr. David Seabury, Consulting Psychologist of the Culver Military Academy; to the persons who have acted as subjects in the tests; and to many others who are not specifically mentioned.

Within the text several cases of particular indebtedness have been noted. The work of Miss Coy has been especially helpful in that it has enabled me to extend the study to limits which otherwise would have been impossible.

To the General Education Board I am indebted for the subsidy under which I have worked.

Most of all I am indebted to Professor Whipple, to whom I owe the opportunity to share in the general study, who suggested to me the problem of specialized ability, whose suggestions and criticisms have been most valuable throughout the investigation, and whose kindnesses have been many quite apart from our academic relations.

To all who have in any way assisted in carrying forward the study I wish to express my most hearty thanks.

HERSCHEL T. MANUEL.

The University of Illinois, May 14, 1917.

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Chapter I

INTRODUCTION: GENERAL STATEMENT OF PROBLEM, METHOD, AND RESULTS

The Problem

It is the purpose of this volume to report the results of a study of talent in drawing. If it may not seem too abrupt, it will give point to the presentation to state in the very beginning the problem around which the research has centered. This problem is twofold:

(1) What are the essential psychophysical characteristics of persons talented in drawing?

(2) How may the test method be used in the diagnosis of talent in drawing?

The Method

The method employed is suggested by the statement of the problem. A number of individuals were selected for their recognized talent in drawing. To these persons mental and physical tests were applied, and other information of a non-experimental character (particularly biographical) was gathered from different sources. In the following pages this material has been brought together and its bearing upon the problem stated has been pointed out.

General and Special Ability

As stated in the Preface, this investigation forms a part of an extensive study of the gifted child. In a

consideration of superior endowment one may distinguish *a priori* two general types. The first is that of high general ability. The child stands above the average of the group in all of his school work. In tests of general intelligence he ranks above age. On the other hand, there are those who appear to have abilities more or less specialized. By endowment or by training they are so equipped as to take special interest in, and to succeed extraordinarily well with, some *one* activity. Perhaps in comparison with their fellows they are particularly good in language, in music, in constructive work, or in drawing. They may or may not belong to the class described as having high general ability, but for doing the particular thing under discussion they do show special aptitude.

This specialized ability we shall call "talent." And it is to this part of the general problem of the gifted child that the attention of the author has been directed. After some preliminary survey it was decided that it would be best, in consideration of the time which could be devoted to the unit of research then projected, to limit the study to investigation of one particular form of talent. Drawing was chosen as the activity of greatest promise for the immediate purpose.

The Test Method

The experimental part of the study of talent in drawing has been carried forward by the test method. It will be serviceable then to recall the characteristics of this method. Any test in which the results are influenced by the mental activity of the subject may properly be called a mental test. Both mental and physical activities are, of course, involved, but they are so inter-

related as to make it unprofitable for our purpose to try to disentangle them. Most of the tests which we have used may be called "mental" tests in this sense. It will be sufficient then to discuss the characteristics of the mental test or, as it might also be called, the psychological test.

The test (*Prüfungsexperiment*), as defined by Stern,[1] is an experiment designed in a given case to reveal "the individual psychical constitution of a personality or a single psychical attribute of it." The same author points out two logical presuppositions of the test: (1) it must really furnish an indication of the quality to be demonstrated; (2) it must assign the one tested in relation to this quality to a definite place in the series of possible results. A very good discussion in English of the nature and purpose of mental tests is given by Whipple.[2] Within itself the test is diagnostic rather than theoretical. Its purpose is "to analyze, measure and rank the status or the efficiency of traits and capacities in the individual under examination." Its value as an instrument of research lies in the use which may be made of these measures, analyses, and ranks. It is a kind of standardized experiment, in which the meaning of the performance is determined by previous research or else by comparison with other results.

A Study of Individuals

The research here reported has been essentially a study of individuals by the test method. Tests and standard performances for the individuals studied are

[1]Stern, W., *Die differentielle Psychologie.* Leipzig, 1911, p. 87.
[2]Whipple, G. M., *Manual of Mental and Physical Tests.* Baltimore, 1914, p. 1-4.

logically presupposed. It has not been the primary purpose either to develop new tests or to standardize old ones. Such a purpose would have carried the study to impossible limits. As a matter of fact, however, the tests at hand seemed insufficient for our purpose, and, for some that were available, comparable results were lacking. Practically, therefore, we have been compelled to do a little work in both developing and standardizing. Yet it must be borne in mind that we have entered these fields only under necessity in an attempt partially to overcome the handicap of a rapidly developing but still incomplete science.

Justification of the Study

No excuse is needed for any type of scientific research. If, however, the reader desires some reference to the literature for a justification of the thing which we have attempted, we may say that we have undertaken the first named of the tasks mentioned by Stern in the quotation below:[3]

"It will be necessary both to 'psychograph' exceptionally gifted individuals as completely as possible and to follow their subsequent mental development, and also to work out types and correlations by the comparison of numerous individuals."

Or, we may add the statement of Dr. Kerschensteiner —a statement which concerns drawing talent more specifically:[4]

"The productions of both the Munich boys stand on the same level with the productions of the two boys [afterwards the German painters, Albrecht Dürer and Hans Thomas] who once made the title-pages [referring to reproductions of early drawings of these painters which Dr. Kerschensteiner has made on the title-pages of his book]. Will they develop also as these? Who can say? We have so far no objective,

[3]Stern, W., The Supernormal Child. *Journal of Educational Psychology*, 2: 1911, 187-188.

[4]Kerschensteiner, Georg. *Die Entwicklung der zeichnerischen Begabung*. Munich, 1905. Preface, xi f.

certain measure for true talent, whether graphic, musical, or linguistic; we have also no sure measure for great ability in abstraction, in scientific or aesthetic imagination, in organization, in observation, or in the technical arts. Usually we recognize these qualities first, when they are in full bloom, but not in the bud. It will be an uncommonly great, but also a very difficult task of experimental pedagogy, to find the key for the judgment of these different talents."

Or, perhaps the reader will find concrete justification for such a study in the following paraphrase of the experience of one of our own subjects:

"I have always liked to draw, but in my childhood I received very little encouragement. No one thought that I could do anything. Even my mother, though she had herself received training in art, did not encourage me. She did not think that I could ever do much with drawing, and she gave very little attention to the drawings which I used to take to her. Both the common school and the high school offered very little opportunity for development in this line, in which I dreamed that some day I might accomplish something. Before entering the university I had no real lessons in drawing except perhaps a few that might be so designated in the common schools. Yet through these years I have continued to cherish my dream. I remember that I was fascinated by the drawings of birds and the like which one of my teachers in the country school used to make after the fashion of the old penmen. I wish that I could go out to teach art to children so that any one who has the desire may have the opportunity also."

Results

The investigation has revealed great individual differences in the mental and physical characteristics of persons who are talented in drawing. These differences are discussed in some detail in Chapter VII. We have been able to make recommendations concerning the types of tests which should be used in a diagnosis of drawing talent, and to point out certain specific problems for further investigation. The discussion of tests in their relation to talent in drawing is presented in Chapter VIII.

Chapter II

HISTORICAL STATEMENT

Development of the Test Method

Various types of scientific research are interdependent. One type of study goes forward a little while, and then another undertakes to utilize the results of the former while they are yet in the making. The two studies advance together and each supports the other. No field is completely developed before workers in another take advantage of the contribution already made.

Such a situation is reflected in the method of this study. Less than a half century ago the first psychological laboratory was established. Since that time, to be sure, rapid strides have been taken, but experimental psychology is still very new. Its problems and methods, not to mention theories and results, are yet matters of discussion and dispute. Psychology, however, had scarcely assumed the experimental attitude, when the psychological experiment began to be standardized into so-called tests. According to Stern,[1] the expression "mental tests" was first used by Cattell in 1890. The phrase was used in an article which appears in *Mind* on "Mental Tests and Measurements." The first draft of the best-known and the most highly developed series of tests, the Binet-Simon tests for general intelligence, was published as recently as 1905. The development in the field of tests was so rapid as to justify the publication in 1910 of Whipple's *Manual of Mental and Physical*

[1]Stern, W., *Die differentielle Psychologie*, 1911. p. 89.

Tests.[2] This important work was expanded into two volumes in 1914 and 1915, and the literature is growing apace.

Naturally, in so new and so difficult a field there is a great deal of confusion and uncertainty. Many of the conclusions are confessedly tentative. The situation is well put by Whipple:[3]

> "There is, at the present time, scarcely a single mental test that can be applied unequivocally as a psychical measuring-rod. The fact is we have not agreed upon methods of procedure; we too often do not know what we are measuring; and we too seldom realize the astounding complexity, variety and delicacy of form of our psychical nature."

It is to this newest phase of the development of experimental methods in psychological study that this investigation belongs. Despite the uncertainties involved, science must use even the imperfectly developed instruments which it has. In so doing, not only will it advance in the immediate direction of the given research, but it will at the same time be perfecting its instruments.

Relation to Education

The preceding paragraphs have set forth the relation of this study to psychology. Just as properly or perhaps even more so, the study may be said to belong to the field of experimental education. We are investigating talent in a school activity. We are using a method which does not presuppose highly trained observers, such as are employed on problems of a more purely psychological nature. We desire the results for immediate application to educational problems.

For our present purpose there is no need, of course, to draw a line between what is psychological and what

[2]Whipple, G. M., *Manual of Mental and Physical Tests*, 1910; Revised Edition, 1914-15.
[3]Whipple, G. M., *Manual*, Second Edition, 1914, pp. 3f.

is educational. And we may even recall the large indebtedness which experimental education has to the psychological laboratory. Cubberly has recently stated[4] that the "experimental investigation of educational problems had its origin, in large measure, among workers in psychological laboratories."

Related Investigations

There have been many studies of drawing, but none of these, so far as the author is aware, corresponds closely in method and scope to the one which is here reported. Ayer has given us recently[5] a comprehensive summary of earlier investigations of drawing and has himself contributed to the general store. Since this summary is readily accessible, a repetition of it here would be quite superfluous. We shall, therefore, mention in this connection only three of the studies which seem to be most closely related to the present one. Other studies will be mentioned only as occasion arises for such reference in the later chapters. Sufficient information for the interpretation of references has been given, it is hoped, in the bibliography at the end of this volume. The detailed results of different studies need be given only so far as they relate to the questions raised in this investigation, and they may best be presented in connection with the discussion of these topics.

The investigation, perhaps, most closely resembling this one was made by Binet.[6] Tade Styka was a young painter who came under Binet's observation. Binet was

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[4]Cubberley, Ellwood P., In the *Editor's Introduction* to Freeman, F. N., *Experimental Education*, 1916.

[5]Ayer, F. C., *The Psychology of Drawing*. Baltimore, 1916.

[6]Binet, A., La psychologie artistique de Tade Styka. *L'Annee psychologique*, 15: 1908 (1909) 315-356.

"curious to know whether an intelligence so young, which practiced already a technique so learned, proceeded by reason or by instinct." Accordingly, with the cooperation of Styka himself and of Styka's father, who also was a painter, he made a rather extensive investigation of the talent and mental characteristics of the young man. He observed the painter at work, gave him various mental tests, questioned him concerning his technique and interest, and brought together facts of a biographical character. Binet was able then to describe fairly well the mental characteristics of the painter and the nature of his talent.

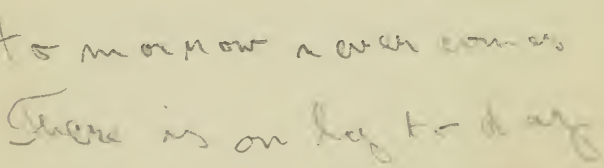
Kik[7] made a study of individuals who were specially talented in drawing. It appears, however, that his data were largely non-experimental. He studied the drawings made by children of special talent, and in some cases observed the children in their drawing. In addition, he obtained supplemental information which may be classed as personal and biographical. Thirteen cases of special talent are included in his study. He discusses the nature of special talent, various types of drawing ability, the influence of heredity and of surroundings, and the relation of drawing and intelligence.

Kerschensteiner's[8] study was a most elaborate one, but also non-experimental except that the drawings were collected under controlled conditions, and in some cases the investigator himself witnessed the drawing. Thousands of drawings were collected under his direction from the school children of Munich, and many children who exhibited special talent demonstrated the fact by draw-

[7]Kik, C., Die übernormale Zeichnenbegabung bei Kindern. *Zeitschrift für angewandte Psychologie,* 2: 1908, 92-149.

[8]Kerschensteiner, G., *Die Entwicklung der zeichnerischen Begabung,* 1905.

ing in his presence. An exhaustive study of the drawings themselves was supplemented by consideration of the drawers in relation to their age, school grade, sex, general school success, the professions of their parents, whether they drew at home, and whether they possessed a picture book. He was able to draw conclusions as to the typical stages in the development of children's drawings, the relation of drawing to general intelligence, and various other important questions in the psychology and pedagogy of drawing. The investigation was of great practical benefit to the drawing instruction of the City of Munich.



Chapter III

TEST GROUPS AND SOURCES OF DATA

General Survey

Tests and supplemental information on 19 subjects chosen for their recognized talent in drawing are reported in this study. In point of school advancement, the subjects fall naturally into three groups: college or university students (5), secondary-school (high-school or academy) students (8), and elementary pupils (6). Accordingly, each subject will be designated by a number to which is prefixed the letter C, S, or E. The letter will serve to indicate the one of the above groups, in the order named, to which the subject belongs.

Eight of the subjects are boys or men and eleven are girls or women. In order to indicate differences in sex, the numbers which indicate the male subjects will be italicized.

The above classification is obviously in terms of school status, but on account of differences in the actual experimentation, it will be found desirable, while retaining the designations C, S, and E, to group the subjects into four experimental groups as follows:

(1) the *academy* group, consisting of subjects *S7* and *S8;*
(2) the *laboratory* group, consisting of subjects S1, *S2*, S3, *S4*, S5, S6, C4, and C5;
(3) the *miscellaneous* group, consisting of subjects C1, *C2*, and *C3;*
(4) the *elementary* group, consisting of subjects E1, *E2*, E3, *E4*, E5, and E6.

The Academy Group

In the fall of 1916 an invitation was extended to Professor G. M. Whipple to make a series of psycholog-

ical tests upon a number of cadets in the Culver Military Academy at Culver, Indiana. The Academy is a high-grade institution of high-school rank. The invitation was accepted and the tests were given on November 16, 17, and 18. Professor Whipple was assisted in the testing by Miss Genevieve L. Coy, Dr. T. S. Henry, and the author. Twenty-two tests of varied character, from which the ones to be reported here are selected, were given. Thirty-two cadets formed the test group, and each cadet (with negligible exceptions) submitted to every test. The group had been selected by the Academy officers to include young men of different abilities, high, low, and average. Classmen from each year of work given in the Academy were included. The ages of the cadets ranged from 14 years, nine months, to 21 years.

It was a part of the task of the author to hold a personal interview with each cadet tested. From these interviews it appeared that two of the cadets (our *S7* and *S8*) were probably talented in drawing. Additional evidence has since been added by statements from Mr. David Seabury, Consulting Psychologist of the Academy, and from the fathers of the two cadets. Unfortunately, it has not been possible to follow up the study by a second interview with the cadets themselves and by securing from them concrete evidences of their ability. The information which we have, however, seems sufficient to merit presentation in the chapters that follow.

The Laboratory Group

The eight members of the laboratory group were chosen for a detailed study. An extended list of tests was applied to these persons by the author himself.

These data were supplemented by means of interviews with the subjects and with others who knew of their work.

At the time of selection S1, *S2,* S3, *S4,* S5, and S6 were students in the Champaign or Urbana High School. They were selected on the recommendations of the supervisors of art instruction, and after consultation with the principals of the two high schools. Each was recommended by the supervisor in charge as among the most gifted in drawing of the then high-school students, who were or had been, under her instruction.

C4 and C5 were at the time of selection students in the Department of Art and Design of the University of Illinois. They were recommended by the Acting Head of the Department as "advanced students who have reached a degree of ability in technique and show originality." C5 was recommended also by the supervisor of art instruction in the high school from which she came to the University.

With the exception of a few tests given to *S2* one evening at his home, all of the tests were applied in the educational laboratory of the University. The subjects apparently took a real interest in the work and applied themselves faithfully. As an added incentive, and since it was realized that the test series would be a long one, each of the subjects was paid for his time. It was possible to apply a few of the tests as group tests, but the greater part of the testing was done individually, and at no time was a test applied to the entire group at once. The testing began on December 7th, 1916, and ended on March 27th, 1917. The time required for each subject ranged from 12 to 16 hours. It was necessary to make individual appointments which were adjusted

to the programs both of the subjects and of the experimenter; consequently, the time could not be controlled as completely as strict laboratory procedure would enjoin. The after-school period of the afternoon was a favorite time for the high-school students, though in some instances evening appointments were made, and a few morning periods were utilized. In the case of the university students both morning and afternoon appointments were made. The order of the tests was likewise varied somewhat with the different subjects; early experience indicated that it would be practically impossible to keep the order constant, and varying conditions at times would have made it unwise to attempt it.

The Miscellaneous Group

During the conduct of the investigation three university students (our C1, *C2,* and *C3*) came to the attention of the author as persons who probably had some talent for drawing. A limited amount of work has been done by the author with these people, and results of certain other tests applied in the educational laboratory by others have been available. The estimate of their drawing talent must rest upon facts gained from personal interviews and from the tests given, except that in the case of *C3,* who has been a student in the Department of Art and Design, we have been able to get additional information from the acting head of this department.

The Elementary Group

In advance of experiment we dare not assume that children will respond to given tests in the same manner as do adults. It is desirable, therefore, in trying out a

method or in studying a group selected for a particular ability, to extend the study to persons of various typical ages. In accordance with this policy six pupils were chosen for our study from the fifth and sixth grades of the Leal School, Urbana. They were selected on the recommendation of their teacher of drawing, Miss Burdelle Ealey, who estimated their drawing talent as among the highest exhibited in these grades of this school.

As stated in the Preface, Miss Coy has spent a large part of the school year in research in these grades. This fact has made possible a very much more comprehensive study of these pupils than would have otherwise been possible, for the results of her work have been freely available and freely used. From this material we have received a wealth of data on the pupils in these grades.

Additional data have been secured from the test group in a series of tests in the educational laboratory of the University.[1] For the purpose of taking these tests, each of the six pupils came to the laboratory on three or four of the Saturday mornings from March 3 to March 24, 1917. In addition, the author did some testing at the Leal School.

Supplemental Information

In addition to the results of the tests, it has been possible to collect a mass of supplementary information which may be roughly characterized as biographical. This information, secured in personal interviews with

[1]In securing these results the author has been ably assisted by Miss Frances Mapel, Miss Dora Keen, Miss Margaret Doherty, Miss Helen Davis, and Miss Florence Boehmer, all of whom are students in Education.

the subjects and from various persons who knew of their work, has been of great value in the interpretation of the experimental results. The contributions of the supervisors of drawing in the high schools, the teacher of drawing in the grade school, and the Head of the Department of Art and Design in the University have been particularly valuable.

Chapter IV

DESCRIPTION OF TESTS

Introductory

In a study of this kind, it would be desirable, if it were at all possible to extend the tests until we could make a complete determination of the personality.[1] This would require, however, an infinite number and variety of tests and sufficient data for the interpretation of the results of each test. Both the tests and the data are lacking. Moreover, it would require a vast amount of time to apply even the tests which are available. A choice of tests must, therefore, be made. In the academy group, the choice of tests was made for purposes other than those of this investigation, but we have chosen from those given a number that pertain to our problem. The tests given to the laboratory group were chosen for this investigation. In the other groups we have both given tests for the purpose in hand and selected from those given by others. Many mental and physical capacities condition the performances in these tests.

One of the difficulties of individual psychology is the variability of performance in a given test as affected by factors like fatigue, state of attention, effort, and general physical condition. We can not be sure that the results of a single test are a typical representative of the ability which we have tried to measure. Consequently, it is desirable to make more than one measurement. In some cases, the same test may be repeated.

[1]Cf. Claparède, Ed. Profils psychologiques. *Archives de Psychologie*, 16: 1916, 70.

In this study, for example, two tests of motor capacity (tapping and steadiness) were given twice to most of the subjects to whom they were given at all. But a repetition of some tests makes them primarily tests of retention. Hence there arises the need of different tests for measuring the same ability. It would be a further advantage, if the different tests were *equivalent,* in the sense that a given score in one test would represent the same performance as that score in the other test. Equivalent tests, however, are not generally available. We must rather rely upon *similar* tests, that is, tests in which the performance is dependent primarily upon the same abilities, but in which the units are not interchangeable.

Before the presentation of the results, a brief discussion of the several tests used will be in order. A statement of the particular tests taken by each subject may be deferred. It will be convenient to describe the tests under certain headings. There will probably be a difference of opinion as to whether they should be grouped in the way which we have chosen. We have no disposition to urge that our own grouping is the best one. As a matter of fact a single test brings into operation a number of mental processes and depends upon various capacities; so that with perfect propriety the test may be placed under different headings, if it be borne in mind that the characterization implied is but a partial one.

I. Tests of General Intelligence

1. The Binet-Simon Tests. The Stanford Revision of the Binet-Simon tests for general intelligence was used. The method of giving and scoring these tests is

fully described by Terman.[2] In representing the total result of the tests we have used the "intelligence quotient" (I. Q.) as explained by this author. The intelligence quotient may be described as 100 times the ratio obtained by dividing the mental age by the chronological age. Reference will be made to the following separate tests of the series:

(a) Memory for Digits. This is a test of immediate memory for digits dictated by the experimenter at the rate of about one a second. After the series has been dictated, the subject attempts to repeat the numbers either (1) in the same or (2) in the reverse order, as may be directed.

(b) Designs. In the designs test two simple drawings are exposed simultaneously for a period of ten seconds, after which the subject attempts to reproduce them. The test occurs in the tenth-year group. One design correct and one "half" correct are required for passing.

(c) Sixty Words. In this test the task is the naming of as many words as possible within a period of three minutes. At least sixty words must be named in order to pass. It is listed in the tenth-year group.

(d) The Clock Test. The clock test is placed in Year 14. The subject is expected to imagine the positions of the hands of a clock at a particular time, and to state what time it would be if the hands were to exchange positions. Three such problems are given, but only two correct answers are required for passing.

(e) Vocabulary. The vocabulary test comes in year 8 and from 10 up. It is designed to measure the extent of one's vocabulary. A list of 100 words of progress-

[2]Terman, L. M., *The Measurement of Intelligence*, 1916.

ively increasing difficulty is offered for definition. In the Stanford procedure the responses are given orally, but, in our own work with some adults, we asked the subjects first to write the definitions. Doubtful places were afterward checked over in conference with the subject.

(f) Interpretation of Fables. The test requiring interpretation of fables is listed in both the 12th and the 16th years. The subject must interpret the situation presented in a fable and generalize this situation in an expression of the "lesson" which it is intended to teach. Five fables are read by the experimenter. A score of 2 is allowed for every correct response and 1 for every response partially correct. Scores of 4 and 8, respectively, are required for passing. No time record is taken. Tests of this type are further discussed by Whipple.[3]

(g) Code. The code test, occurring in age 16, is essentially a form of substitution test. The symbols for the letters are shown to the subject and explained to him in some detail. He is informed that he will be asked to write something in the code. After the code has been removed from sight, the words *Come quickly* are given, and the time required for writing them is recorded. The test is passed if the time has not exceeded six minutes and if not more than two errors have been made. In our own work it seemed desirable to have a finer method of scoring than that used by Terman. In fact we have used two methods, which are indicated below. We should have used the second of these in all of the test groups, except for the fact that the time required for *S8* was not recorded accurately.

[3]Whipple's *Manual*, pp. 666ff.

Method (1). In the first method of scoring, 100 points were allowed for an errorless performance. Then 10 points were deducted for each error and for each 100 seconds (or part thereof) in excess of 200 seconds required for completion of the test. This method is used in the scores of the academy group.

Method (2). The score used in the other groups consisted of the number of seconds required for completing the test, divided by the number of correctly coded letters. In other words, the score is the number of seconds per correct letter.

The code test requires reproduction of visual forms and would seem to be of special interest with reference to ability in drawing. One would think that a good memory for visual forms would be an asset both in this test and in drawing. Of course, we can not assume that visual imagery is required for a good record in the test.[4] Healy and Fernald,[5] who have described the test, characterize it as one requiring "close attention and steadiness of purpose."

(h) Problem of the Inclosed Boxes. The subject is asked to state the number of boxes in each of the following combinations: (1) one large box containing 2 smaller boxes, each of which contains 1 tiny box; (2) one large box, 2 smaller, 2 tiny; (3) one large box, 3 smaller, 3 tiny; (4) one large box, 4 smaller, 4 tiny. The test belongs to the 16-year (average-adult) series. Three correct answers are required for passing. The test has a special interest in this study because the task is to deal with a situation which lends itself to visual representation.

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[4]Cf. Terman, *op. cit.*, p. 331.

[5]Healy and Fernald. Tests for Practical Mental Classification. *Psychological Review Monographs*, 13: 1911, No. 2.

(i) Paper Cutting. The paper-cutting test is given in the superior-adult series. The task requires imagination of a visual situation. A blank paper is folded in the middle parallel to an edge and then again at right angles to this fold. The experimenter then cuts a small notch in the middle of the folded edge, and asks the subject to draw the results of the folding and cutting as they would be seen if the paper were unfolded.

(j) Logical Memory. In the superior-adult series is a test which requires the repetition of the thought of a paragraph read by the experimenter. Two paragraphs are provided, and success with one of them is sufficient to pass the test.

II. Tests of the Higher Thought Processes

A. Linquistic Invention and Language Ability.

2. Word Building (Whipple). In the word-building test the subject is given six letters with instructions to form as many different words as possible from these letters in five minutes. A word may contain any number of letters from one to six, but must not contain the same letter twice or any other letter not in the list. For our purpose two tests were used having the letters AEOBMT and EAIRLP, respectively. The score is the number of words formed in the time allowed. This test requires a certain fertility of vocabulary and constructive imagination. For further discussion see Whipple's *Manual,* pp. 640ff.

3. Language Tests (Trabue). The Trabue language tests are fully described by the author.[6] A more general treatment of the type of test to which they be-

[6]Trabue, M. R., *Completion Test Language Scales,* 1916.

long may be found in Whipple's *Manual,* pp. 649ff. The tests consist of a series of sentences in which certain words are omitted and the omissions indicated by blank spaces. The task of the subject is to fill as many of the blanks as possible so that the sentences will make good sense. Five minutes are allowed for each of the series J and K, and seven minutes for B and C. The scoring is done by allowing two points for each sentence correctly completed and one for each sentence completed with only a minor error. Trabue's monograph must be consulted for details of the scoring. He refers to the method as one that "psychologists have come to regard as an unusually good test of ability to think about words and language forms."[7] It is significant that the tests are called "language" tests, and that they appear to have a high correlation with general intelligence.

4. Invention of Story (Winch). This is a form of composition test in which the subjects are asked to write a story containing a given list of ten words (*thief, landlord, crab,* etc.) The test is discussed by Whipple in the *Manual,* pp. 634ff. As used in this experiment, the performances were scored independently by 20 judges, most of whom were members of an advanced class in education. The papers were read to the judges by the instructor and each paper was marked on a scale of 100 points as soon as it was read. It was assumed that 100 represented a performance that would not be surpassed once in a hundred papers, that 50 represented average performance, etc. The final score is the average of the scores of the different judges.

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[7]Trabue, M. R., Completion Tests for Public School Use. *Fifteenth Yearbook of the National Society for the Study of Education,* 1916, pp. 52-59.

B. Apprehension of Verbal Relations, or Controlled Association.

5. Hard Opposites (Henry). The opposites test is a very familiar form of controlled association test. (See Whipple's *Manual,* pp. 79ff.) A list of 20 stimulus words specially selected by Dr. T. S. Henry was used in this experiment. Each word was exposed on a separate card and the time of the response was taken by means of a stop-watch. If the response was incorrect, the subject was so informed, and he was allowed to suggest the correct response, or at least to try again. If no correct response was made in 30 seconds, the experimenter passed on to the next word and counted 30 seconds as the time of response. The score is the total number of seconds for 20 responses.

6. Analogies (Whipple). The analogies test is another form of controlled association test. It is described in Whipple's *Manual,* pp. 89ff. On each of twenty cards there are three words arranged in the form of a proportion with the fourth term missing. The task is to supply a fourth word which shall have the same relation to the third as the second has to the first. The relation between the words changes from card to card. Time is recorded and the same provision is made for errors as in the hard opposites test. Whipple's lists A, B, and C have been used. The score is the total number of seconds for the 20 responses (academy group), or the average number of seconds for one response (other groups).

C. Invention from Graphic Forms.

7. Ink-Blots (Whipple). The ink-blots test is described in Whipple's *Manual,* pp. 620ff. The subject is

shown a series of 20 ink-blots and is asked to respond with the first object which he thinks of that the blot resembles. We used essentially "method (b)" as described in the reference cited, except that, instead of requiring a response by tapping or by the word "now," we asked the subject to respond by making the object thought of. It seemed that this procedure might simplify the task of the subject, in that it would give him fewer things to hold in mind; and also that it might serve as a check against a premature response, which the subject might make before the object thought of had really come to the focus of attention. If the subject was unable to respond within a minute, the experimenter proceeded to the next card. In the computation of results, however, all times of response which exceeded 15 seconds and all failures to respond were counted as 15 seconds. The use of 15 seconds for this purpose appears to penalize the slow response sufficiently and yet not too severely. The score is the average number of seconds required for one response.

8. *Pictorial Imagination* (after Rossolimo). The pictorial imagination test was modelled after Rossolimo's test for *Einbildungskraft.*[8] It consisted of twenty incomplete drawings of familiar objects in the order given: *automobile, dog, watch, cow, tree, boat, chicken, locomotive, piano, person telephoning, bicycle, chair, shoe, church, pig, bed, bottle, table, face, and hat.* Each of these incomplete pictures was traced on a separate card. Directions were given to the subject substantially as follows: "I am going to show you a number of incomplete pictures. Tell me in each case what the picture is in-

[8]Rossolimo, G. Die Psychologischen Profile. *Klinik für psychische und nervöse Krankheiten,* 1911, Bd. VI, Heft 3.

tended to represent. If you make a mistake, I shall say, 'No,' and you must go on until you have guessed it correctly. Do not be afraid to guess, for the chances are that your guess will be correct." Time was taken with the stop-watch for each response, but no more than 60 seconds was allowed for one response. The score was calculated precisely as in the ink-blots test.

D. Understanding and Reasoning.

9. Directions (Woodworth and Wells). The directions tests are described by Woodworth and Wells.[9] The second and third of the tests described, easy (a) and hard (b) were used. In these tests a printed blank is placed before the subject with instructions to do as rapidly as possible without making mistakes just what the blank says to do. Time is recorded for the completion of all the tasks assigned. The score is computed by allowing 100 points for an errorless performance, subtracting 5 for each error, and dividing the remainder by the number of seconds required for completing the test. A number of activities are obviously brought into operation in this test. It is a kind of complex reaction experiment in which constantly changing tasks are assigned, and in which the time for apprehending the detailed instruction is counted as well as the time for responses.

10. Equivalent Proverbs. This test requires the recognition of similarities in thoughts differently expressed. Two lists of proverbs are presented to the subject. One proverb in each list means substantially the same thing as one in the other list. For example, "A friend is better than fortune" expresses substantially the same sentiment as the Arabian proverb, "Good friend

[9]Woodworth, R. S. and Wells, F. L. Association Tests. *Psychological Review Monographs*, 13: 1911, No. 5, pp. 68ff.

is better than money in pocket." The task of the subject is to indicate which one of the proverbs in the one list corresponds to each one in the second list. For convenience the proverbs are printed in parallel columns on the same sheet, and those in one list are numbered. Time is taken for the completion of each sheet. Laboratory sheets I, II, and VI (from the Carnegie Institute of Technology), requiring 29 judgments, were used. The score is obtained by dividing the total number of seconds required for the three tests by the number of correct answers given.

11. Arithmetical Reasoning (Bonser). These tests are Tests I and II, as described in Bonser's monograph.[10] They consist of simple arithmetical problems, and were used by Bonser "for testing the mathematical judgment." Two points are allowed for each correct solution, and one point for each two-step problem in which only one step is correctly solved. The final score is the sum of these points.

12. Reasoning (Thurstone).[11] This test consists of 20 samples of reasoning containing two premises and a conclusion, of which the following is a sample: "Silver is heavier than iron; copper is lighter than silver; therefore copper is heavier than iron." The task is to mark each sample plus or minus according as the conclusion is true or false. The test has been used by us as a work-limit test. When so used, the score is the number of seconds required for the completion of the test, divided by the number of correct judgments made. In Miss Coy's tests of the children, the test was given with a time-limit of five minutes. The score in this case (results of

[10]Bonser, F. G. *The Reasoning Ability of Children of the Fourth, Fifth, and Sixth School Grades.* New York, 1910. Pp. 1ff.

the elementary group) is the number of correct minus twice the number of incorrect judgments.

E. Mental Manipulation of Spatial Forms.

13. Hand Test (Thurstone).[11] The test sheet contains 49 pictures of right and left human hands in varying positions. The subject is asked to check the right or left of two small squares according as a right or left hand is represented. In tests of the high-school students and adults the time for completing the test was recorded. The score was computed by dividing the number of seconds required for the completion of the test by the number of hands correctly checked. In the tests of the elementary group the test was given with a time limit of three minutes. In this case the score is the number of hands correctly checked, minus twice the number of hands incorrectly checked.

14. Spatial Relations Test (Thurstone).[11] In this test a lozenge-shaped figure is imagined to be a card. The drawing indicates a hole in one corner. It is required that the subject in imagination lift this card, turn it over, fit it upon the only one of two similar drawings which it will match, and indicate the location of the hole upon the matched figure. The test was given as a work-limit test. The score is the number of seconds required for completing the test, divided by the number of figures correctly matched. In practice we found a great deal of difficulty in getting students to understand and to hold to the task assigned. It is, therefore, doubtful whether the test should be used to measure the power of an individual mentally to manipulate visually presented forms.

[11] We are indebted to Dr. L. L. Thurstone of the Carnegie Institute of Technology for the Thurstone reasoning test and the other tests in the title of which *Thurstone* occurs.

15. Punched Holes Test (Thurstone).[11] A series of diagrams representing a sheet of paper folded in different ways and punctured at different places is placed before the subject. The task is to determine the location of the holes as they would be seen if the paper were unfolded. One point is allowed for each hole correctly placed, and the sum of these points constitutes the score.

16. Painted Cube (Rugg). The painted cube test is the same as that used and described by Rugg in his study of mental discipline and descriptive geometry.[12] The student is given a paper containing the statement, "A three-inch cube, painted on all sides, is cut into one-inch cubes." He is required to state in blanks properly provided how many one-inch cubes have paint on three sides, two sides, one side, and no side, respectively. Rugg gave the test on a time-limit basis (80 seconds.) Since there was no assurance that the different elements of the test were of equal or evenly graded difficulty, this method of giving the test seemed to us unwise, and accordingly we have used the work-limit basis. The preliminary instructions also were modified for our purpose. We expected to use the test with children and with other subjects who might be unaccustomed to think in terms of the language of the test. Hence it seemed to us advisable to explain briefly what a cube is and what it means to divide it into smaller cubes. The score is the number of seconds required for completing the test, divided by the number of correct answers given.

We attempted to simplify the language of the "geometrical objects" test described by the same author, and to use it for our study, but it proved to be rather un-

[12]Rugg, H. O. *The Experimental Determination of Mental Discipline in School Studies*, 1916, pp. 41f.

suited for our purpose. The difficulties were those of language and unfamiliarity with one or more objects named. In this test the subject is asked to imagine various objects and to state the number of lines which would be required to construct them in space.

Rugg regards the Painted Cube test as a measure "of ability in mental manipulation of strictly geometrical elements.... The diversity of the tests [painted cube and geometrical elements] and the short time given for the solution of each one are believed to prevent effectually the building up of a definite method of solution through reasoning processes (organization, etc.). In other words, it is believed that a solution of each of these tests is confined to (1) a mental picturing of the object, (2) the counting of the various lines and surfaces, (3) the writing of the various answers.[13]."

F. Aesthetic Judgment.

17. Tests of Aesthetic Appreciation (Thorndike). Professor Thorndike has recently described certain tests for aesthetic appreciation, among which are a few tests for appreciation of graphic forms.[14] Professor Thorndike graciously allowed us to secure from his printer copies of the original series from which these tests were chosen. The forms reproduced in the article cited are arranged in seven series: two series of five rectangles each, two series of four crosses each, one series of five ladder-like designs, and two series of four rectangles each in which are located two vertical lines in different positions. The subject is asked to arrange the figures in each series in a rank order on the basis of which is

[13] *Op. cit.*, p. 42.

[14] Thorndike, E. L., Tests of Esthetic Appreciation. *Journal of Educational Psychology*, 7: 1916, 509-522.

the "best looking," "next best looking," and so on. The original drawings, from which those printed in the article were selected, proved rather impracticable for our purpose. The problem of arranging the full series in a rank order was too complex. The results given for the laboratory group are based upon tracings made from the original sheets of the forms represented in the article. In other groups we used mimeographed forms drawn on a smaller scale, the same scale as used in the article. The scores are based upon the first five only of the seven series presented by Professor Thorndike. Early experience with the other two series (the rectangles containing two vertical lines) led us to omit them from the later tests. On the one hand, they seemed to overemphasize considerations of symmetry; on the other, there appeared a tendency to imagine that they represented objects. In measuring the performance of a given individual in the test, the amount of each deviation of his judgment from the order established by the consensus of opinion as given in the article was noted. For example, if a figure is placed first by the subject, when the consensus of opinion has placed it third, the deviation is counted as two. The score is the sum of the several deviations in the five series.

18. Test of Aesthetic Judgment (University of Illinois). This test was made up during the course of our study.[15] It is built upon the same principle which the Binet-Simon series has long utilized in its test of æsthetic comparison. Our series consists essentially of a number of paired pictures or drawings, the one of which is more beautiful, prettier, or more pleasing in

[15]The possibility of such a test was suggested by a series of comparisons which Miss Coy had prepared. Professor E. J. Lake of the Department of Art and Design contributed valuable suggestions, and Miss Hilda Christensen, a student in that department, prepared some of the drawings.

appearance than the other. Some of the drawings or pictures were clipped or copied from art or architectural publications, and others were drawn or designed for our purpose. Seventy comparisons constituted the series. From this number we selected, on the basis of our results, 40 for the final score. In each of the 40 comparisons which we retained, the consensus of opinion of about 20 adults and high-school students who submitted to the test, confirmed our personal judgment as to which was the better—except in the case of one pair of architectural pictures, where the judgments were equally divided. In this case we continued to count that one the better which the author, from whose work the pictures were chosen, had pointed out as the more beautiful.[16]

Directions to the subjects were substantially as follows: "In this experiment you will be shown a series of drawings or pictures of various objects. Two drawings or pictures representing the same kind of thing will be presented at the same time. In each case you will be expected to name which of the two objects represented has the more pleasing appearance. If you like the appearance of the one to your right the better, you will say 'Right,' if you like the appearance of the one to your left the better, you will say 'Left.' Your choice should be made on the basis of the beauty or the prettiness of the objects represented as these appeal to you. Do not try to select according to any rules, but entirely according to the way they look to you. The letters which sometimes occur on the drawings or pictures indicate nothing in this connection, and you will pay no attention whatever to the way the figures are mounted on

[16]Robinson, John B. *Architectural Composition*, Second Edition, London and New York, 1908.

the cards. Remember to name the one you like better." In almost all cases the subjects were asked also to state, if possible, the reason for each choice.

The score is computed by allowing 2½ points for each correct choice made.

III. Tests of Memory and Learning

A. Logical Memory.

19. Marble Statue (Whipple). The *Marble Statue* test is used for a measure of logical memory. The material of the test is a passage of simple prose. The selection is read to the subject, who immediately thereafter attempts to reproduce in writing what has been read. He is instructed to use, if possible, the original words, otherwise his own words. The time taken for the reproduction is not recorded. The test is fully described by Whipple in the *Manual,* pp. 571ff. The method given by Whipple was used except that the underlining was omitted. The score is the number of ideas correctly reproduced.

20. Dutch Homestead (Whipple). This test is similar to the *Marble Statue* test, except that the subject reads the passage himself. See Whipple's *Manual,* p. 574, "Variation of Method, (1)." The score is the number of ideas correctly reproduced.

21. Cicero (Whipple). This test is similar to the *Marble Statue* test and it is scored in the same way. See Whipple's *Manual,* p. 575.

22. Lincoln and the Pig (Whipple). This test also is similar to the *Marble Statue* test and it is scored in the same way. The selection used is entitled, "*How Mr. Lincoln Helped the Pig.*" This test was given to the

elementary group. Both immediate reproduction and reproduction after two weeks were required. See Whipple's *Manual,* p. 573.

B. Memory for Visual Forms.

23. Memory for Lineal Figures, with Recognition (Rossolimo). This test is taken from the Rossolimo series.[17] The drawings (simple nonsense figures) given in the Rossolimo pamphlets were used. The directions for the test were in substance: "I am going to show you ten figures or drawings. You will look at each for a period of two or three seconds, and, after you have seen them all, I shall give you 25 figures, some of which are just like those which you will have seen. You will be expected to pick from these 25 the 10 which you have seen." The original 10 drawings were exposed by turning the pages of the small pamphlet in which they were printed. The 25 drawings were mounted on cards. No time was recorded. The score is the number of figures recognized.

24. Memory for Colored Figures, with Recognition (Rossolimo). This test is similar to the one just described and is scored in the same way. It is taken from the same source. The figures in this test are colored areas.

25. Memory for Pictures, with Recognition (Rossolimo). This test is another from Rossolimo, and is similar in method and scoring to the two already described. Pictures of landscapes are used in the test, instead of meaningless figures as in the two preceding tests.

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[17]Rossolimo, G. Die psychologischen Profile. *Klinik für psychische und nervöse Krankheiten,* 6: 1911, No. 3.

C. Learning.

26. Substitution (Thurstone).[11] The Thurstone substitution test is a new form of a well-known test. Twenty words, (umbrella, equinox, etc.,) are printed at the top of a large sheet of paper. Below these are printed in vertical columns and in varying order the initials of these twenty words. Each initial is followed by a blank space. There are thirty columns of these initials each containing twenty letters. The columns are arranged in sets of three and these sets are numbered from one to ten. The subject is instructed to fill in the blanks opposite each letter with the last letter of the word at the top of the paper, of which the letter given is the initial. At the end of each minute the subject must stop work in the section in which he then is and shift to the succeeding section. Ten minutes are, therefore, required for the completion of the test. The result is a record of the number of substitutions made during each of ten successive minutes in which the task remains the same and the material becomes progressively more familiar. The score is the total number of correct substitutions made in the 10 minutes. The activity required is, of course, complicated. Persistence of effort and concentration of attention are put at a premium. Ease of memorizing and rapidity of reaction also tend to increase the score.

27. Perceptual Learning. The perceptual learning test may be described as a test of the memory for simple nonsense figures or drawings in which repeated trials are made and in which the memory is tested by attempted reproduction. The figures are generally similar to those used by Judd and Cowling in their study of the percep-

tual process.[18] The figures consisted of simple end-to-end combinations of four, six, eight, and ten, straight and curved lines. One figure was exposed for a period of five or six seconds, and after the copy was removed the subject tried to reproduce what he saw, making it as nearly like the original as possible. Five trials were thus given with each figure in the order as given above. After each attempted reproduction the figure drawn was laid aside or turned over in order that the subject might not be influenced in the observation or subsequent drawing by the sight of what he had just drawn. The score in the test was calculated from the performance in the fifth trial at reproducing each figure.

In order to assure accuracy in the scoring, a rather elaborate method was employed. The score is expressed in terms of deductions as follows: (A single segment of the line is called a "curve.")

(1) 1 point for each error in the type of curve, for example, the use of a straight line where the line should be curved, or of a convex curve where it should be concave;

(2) 1 to 3 points for gross malformation of the separate curves in the figure as a whole;

(3) 4 points for each extra line;

(4) 4 points for each omitted line; or 2 points, if the general form of the whole was preserved;

(5) 1 point for each ten-degree deviation from the true direction of each curve, provided that such deductions did not exceed 4 for each curve.

[18] Judd, C. H., and Cowling, D. J. Studies in Perceptual Development, *Psychological Review Monographs*, 8: 1907, 349-369.

In measuring the deviations from the true direction, a special type of transparent protractor, which had been planned and used by the author for the measurement of slant in handwriting, was used.

28. Mirror Drawing (Star Test). In the mirror-drawing test, the subject is required to trace the outline of a five-pointed star seen in a mirror. Time is recorded for the completion of each tracing. When two hands are used, the right-hand record is taken first—except in the case of one left-handed subject, who traced the drawing first with his left hand. The test is discussed by Whipple in the *Manual,* pp. 485ff. The score is the number of seconds required for each tracing.

D. Imagery.

29. Questionary (Betts). An attempt was made to discover the imagery used by the subject by means of the Betts questionary[19] for images voluntarily evoked. Only the questions for visual, auditory, and kinaesthetic images were used. The rather long list of questions for visual imagery was reduced in length by the omission of Part IV containing questions 25-32. Our subjects were untrained in psychological introspection. We adopted rather lengthy preliminary instructions in an attempt to overcome partially this lack of training. In these instructions we attempted to explain the nature of the image in the fields of sight, audition, and kinaesthesis, and gave the subjects a little practice in reporting upon their images. The results of the tests can be termed "introspections" only in a very loose sense, but it seemed worth while to give the method a trial in this connection. It is the task of the subject to classify

[19]Betts, G. H. *The Distribution and Functions of Mental Imagery.* (Doctor's Dissertation, Columbia University, 1909) pp. 20ff.

the images which are evoked in response to the directions. These are classified according to seven "degrees of clearness and vividness," which are specified in the "key" given. The degrees named range from (1) "perfectly clear and as vivid as the actual experience," to (7) "no image present at all, you only *knowing* that you are thinking of the object." The results are expressed numerically in two ways: (1) The percentage of images in each modality reported as having each degree of clearness is computed. (2) Each number (1 to 7) of a degree of clearness is regarded as a score, and all of these partial scores in a given modality are added to produce a number which represents the vividness of the imagery reported. If, for example, the sum of the partial scores is large, it indicates that many reports were made of images belonging to the lesser degrees of clearness. By comparison of these scores with those given by Betts, one may presumably find out how the vividness of the imagery of a given individual compares with that of the average person.

We supplemented Bett's questionary with questions of our own also, in order to find out as much as possible of the clearness particularly of the visual imagery of the subjects to whom the questionary was given.

IV. Tests of Reading

30. Reading Forward (Whipple).[20] This test is used to measure the speed with which one can read aloud a given passage of simple prose. The selection used was a simple description of Indian life. The score is the number of seconds consumed in the reading of the passage.

31. Reading Backward (Whipple).[20] In this test the subject matter is of the same kind as that used in the preceding test. The first word, however, appears at the right end of the bottom line, and the subject must read backward toward the usual place of beginning. Furthermore, there is no punctuation, capitalization, or spacing between words. Within the word, the letters are in their usual left-to-right order. The test demands a certain familiarity with verbal combinations and an apprehension of contextual relations. The experimenter corrects each error in the reading, but does not help the subject otherwise except in cases where the reader pauses for as long as 30 seconds. The score is the number of words read in five minutes, or, if the passage was completed in less time, the number of words which presumably would have been read in the period.

V. Tests of Observation

32. Cancellation (Whipple). Four cancellation tests were used: the cancelling of *a*'s on the *hpl* blank by the work-limit method; the cancelling of *a*'s on the *zcy* blank with a time-limit of two minutes; the cancelling of triangles on the geometrical forms blank by the work-limit method (or a time-limit, if the work was incomplete at the end of two minutes); and the cancelling of *7*'s on the numeral blank with a time-limit of two minutes. The four printed forms are identical with those described by Whipple (*Manual*, p. 309). The cancellation test is so familiar as to require no further explanation. Three methods of scoring are used in these results: (1) When the test is regarded as a time-limit test (except as noted below), the score is the number of symbols correctly cancelled minus twice the number of symbols omitted in the

[20] For a further discussion of the reading test, see Whipple's *Manual*, pp. 332ff.

portion of the blank covered. (2) When the test is regarded as a work-limit test and the time is recorded for completing the blank, the score is the number of seconds consumed, divided by the number of symbols correctly cancelled minus twice the number omitted. (3) In Tables 3 and 4, a third method of scoring the 7's test is used in order to make our scores comparable to those submitted as a background. In these tables the score is the number of symbols cancelled divided by the number of seconds required.

33. Observation (Rossolimo). This is Rossolimo's test of "Beobachtungsfähigkeit."[21] The material employed consists of ten pictures and drawings. Our method of giving the test is as follows: A question is asked the subject before the exposure of each drawing. He is expected to respond as soon as possible with the right answer. If his answer is incorrect, he is so informed and opportunity to give the correct response is given. Not more than a minute is allowed for each question. Time is taken with the stop-watch from the beginning of the exposure until the correct response is indicated. The problems given are substantially as follows and will explain the nature of the test:

1. You will be shown a picture of a face. Tell me as soon as you can what is lacking in the picture. (An ear is lacking.)

2. The next is a picture of a balcony on the front of a house. Tell me where the master of the house is. (The profile of a face is made a part of the bracket supporting the balcony.)

[21]Rossolimo, G. Die psychologischen Profile. *Klinik für psychische und nervöse Krankheiten*, 6: 1911, No. 3.

3. Next is the picture of two trees. Find the man's face. (The face is between the branches and trunks of the trees.)

4. Next is a steamboat on the lake. Tell me whether it is moving or standing still. After the subject has replied he is asked "why," and the time is recorded to the point where it is evident that he has the correct explanation. (The steamboat is drawn with the absence of steam or smoke and the subject can judge that it is moving only by the wake behind and the foam in front.)

5. Next is a picture of two tables. Tell me how they are different. (One has two drawers and the other but one. The problem is complicated by the representation of the same objects but of different sizes *on* each table.)

6. Next are the pictures of two soldiers. Tell me how their uniforms are different. (The outstanding difference is in the reversal of two colors in the two uniforms. As soon as the subject has indicated that he knows this difference, he is asked to indicate what other difference there is. The other difference is in the number of buttons on the coats.)

7. Next is the picture of a hunter with his dog. Tell me what is the trouble with the dog's going. Why doesn't the dog go along. (The dog has only two legs, but the picture is so drawn as to allow the interpretation that the other two legs are hidden behind those which are shown.)

8. Next is the picture of a summer house. Where is the bird? (The bird is formed by the outline of the top of the roof.)

9. Next is the picture of a river. Tell me whether it is shallow or deep. (It is shallow, because some one

has just walked across it. The subject is required to give the correct reason.)

10. On the next page are several colored dots. Can you find any regularity in the arrangement of the dots? (The black dots are arranged in a circle, while the others are scattered about.)

In this test, as in the test for *Einbildungskraft*, Rossolimo appears to have omitted the time of response in reckoning the score. As we have used the test the time has seemed significant. We have accordingly scored the test by finding the average time of response, counting 15 seconds for all responses or failures requiring more than 15 seconds. (The reason for using the 15-second limit has been explained in the case of the ink-blots test and is the same for this test.)

34. Stamp Test (Whipple). The stamp test is described in Whipple's *Manual,* pp. 376ff. A cancelled two-cent postage stamp mounted on a white background is given to the subject with instructions to write a complete description of it. The numerical score, which we have used, is based upon an allowance of one point for each feature of the stamp which was mentioned.

35. Spot-Pattern (McDougall). The spot-pattern test is described by Whipple (*Manual,* page 290ff.) We used the disc tachistoscope and five seven-spot patterns. The time of exposure was approximately 1.6 seconds. In this test seven spots variously arranged are exposed for the short period indicated and the subject attempts to reproduce the pattern on cross-section paper. The exposures are repeated until the reproduction is correct. In the case of all of our subjects whose results are reported, each attempted reproduction was left in view while the next was being made. It is doubtful

whether the results of *S2* are comparable with those of the others, since the cards were given in a reverse order, owing to a difficulty arising in the first part of the test. The score is the average number of exposures required per card.

VI. Tests of Sensory Discrimination

36. Test for Color Vision (Nagel). The Nagel test for color vision is described in Whipple's *Manual,* page, 190ff. The test consists in the identification of red, green, and gray spots on white cards. The purpose of the test is to test the normality of color vision.

37. Discrimination of Differences. It was thought desirable to test the ability of our subjects to distinguish small differences in form and size. We desired a test that would not require the elaborate precautions of an ordinary experiment in psychophysics, which would require little or no apparatus, and which would allow prolonged viewing of the forms with as much eye movement as might be desired. We found no such test described in the literature. Hence we set about to make one. The first series consists of seven pairs of straight lines, seven pairs of angles, and six arcs of circles. Each pair is arranged on a 4 x 6-inch card. The position of the lines vary somewhat among different cards, that is, on some they are arranged in a horizontal line, on others they are inclined toward each other, etc. On the same card, however, each line occupies a corresponding or approximately symmetrical position with reference to the vertical axis of the card. The straight lines, angles, and arcs alternate in order of presentation. The straight lines differ by a small amount in length. The size of the angles differs slightly, while the length of the sides re-

mains constant. The curvature of the arcs differs slightly. It was intended that the arcs should have cords of the same length, but it was found that in one instance at least this aim was not realized. The intention was to eliminate the operation of illusions as far as possible and to require a judgment on the basis of two similar visual presentations. The subject is asked which of the two lines is the longer, of the two angles the larger, and of the two curves the flatter, that is, more nearly a straight line. Each card is judged twice. The first judgment is made in ignorance of the fact that none of the cards has on it two equal magnitudes, and the subject is allowed to judge the two magnitudes equal in cases where he could discriminate no difference. After the test in discrimination of proportions has been given (where it is given at all), the subject is informed that there is in fact a difference in each pair judged, and a second judgment is made without reference to the first. In this second judgment, the subject is required to discriminate between the two whether he can distinguish a real difference or not. The score is the sum of the correct judgments made in the two trials. Judgments of "equal" in the first trial are given half credit.

38. Discrimination of Proportions. The test in discrimination of proportions is similar to the one just described, except that in this case proportions are judged. There are twelve cards, six containing four straight lines each and six containing four angles each. The lines and angles are so arranged that one could say, for example, if the proportions were true, "The length of the first line is to the length of the second as the length of the third line is to the length of the fourth." As a matter of fact none of the proportions is a true one. As

in the test of discrimination of difference, the test is given twice. In the first case the subject does not know that all of the proportions are not true, and he is allowed to answer that a proportion is a true one. If he judges the proportion not to be true, then it is required that he state whether the fourth line is too long or too short (or whether the fourth angle is too large or too small). Preliminary to the second judgment the subject is informed that the proportions are all untrue and he is asked to state, independently of his first judgment, whether the fourth line is too long or too short (or whether the fourth angle is too large or too small). The score is the sum of the correct judgments made in the two trials. In the first trial, judgments that the proportions are true are given half credit.

VII. General Physical and Motor Tests

39. Tapping. In the tapping test the rate of tapping with each hand is ascertained. For this purpose we used a tapping-board stylus, seconds pendulum[22] kymograph and smoked paper, and double time-marker as recommended by Whipple (*Manual,* pp. 130ff.) The apparatus and method were explained and illustrated to the subject before taking the record. A record of 30 seconds, presumably at the subject's maximum rate, was secured for each hand. Usually the experimenter allowed the subject to run over the period two or three seconds in order to be sure to get a record for the full 30 seconds. The usual order was to take the right-hand record first. Occasionally, however, apparatus or other difficulty seemed to make it advisable to take a second

[22]In certain tests a Jacquet chronometer was substituted for the seconds pendulum.

record with one of the hands or both. The score is the number of taps recorded in 30 seconds. The results in the tables are averages of records taken on two different days, except in the cases of *C2, C3,* and C4. For the first two of these, only one record is given; for C4 the results are the averages of three records.

40. Steadiness of Motor Control: Involuntary Movement. The steadiness test utilized the brass plate recommended by Whipple (*Manual,* pp. 155ff.) The record was made by means of a seconds pendulum (or Jacquet chronometer), double time-marker, kymograph and smoked paper, and electrical accessories. The apparatus and method were explained and illustrated to the subject, and he was allowed to try the needle before making the record. The subject was seated before the instrument. Difficulty was experienced in getting some subjects to assume a position with the angle between the forearm and upper arm the same as that recommended by Whipple, and it was thought best not to insist on this point. The subject was instructed to insert the needle into the hole and as far as possible to hold it so that it would not touch the sides of the hole. Each time the needle touched the side of the hole, the contact completed a circuit which actuated one arm of the marker. In the case of adults and high-school students, records were obtained for Holes 8 and 9, the last two in the series. In the case of the children, records were made in the first sitting for Holes, 6, 7, and 8, and in the second for Holes 7 and 8. Usually the subject was allowed to hold the position a little longer than 15 seconds in order to assure a good record of at least that length. Right and left hands were tested alternately. The steadiness tests, except in the case of *C2* and *C3,* were repeated on a different day.

For *C2* we have but one record; for *C3* a partial second record was made in the same sitting. The tests were given in the same periods as the tapping tests. In the first series, the steadiness tests were preceded by tapping tests and in the second series the steadiness tests were given first. The score is the number of contacts in 15 seconds. In case of long continued contacts the number of contacts which would have occurred in the same period was estimated from other parts of the record.

41. Aiming. The aiming test was given substantially as described by Whipple (*Manual,* pp. 147ff.) In this test the subject attempts to hit with a pencil by full-arm strokes the intersections of a series of crosses on a target paper. The target is mounted on a suitable baseboard at about the height of the shoulder and at a distance of nearly a full-arm length. Three attempts are made to strike each of ten points. The score is the average distance (in millimeters) between the 30 marks where the pencil strikes and the points at which the subject aims. In our work, except for a left-handed subject, the right hand was tested first.

42. Strength of Grip. The strength of grip was measured for each hand. The improved form of Smedley's dynamometer sold by the C. H. Stoelting Company was used. Three trials were made with each hand alternately. The score (in kilograms) is the best record made in the three trials.

43. Weight. The children were weighed in their ordinary clothing. The weight is expressed in pounds.

VIII. Tests of Handwriting and Drawing

44. Handwriting. A sample of handwriting was taken by having the subject write from memory (or

from copy in case he needed to refer to it) the first stanza of "My Country 'tis of Thee." The subject wrote for two minutes, and repeated the stanza if necessary to fill out the time. It was explained to him that the test was one both of speed and quality. The samples thus secured were marked by means of the Ayres scale by four judges.[23] The final score is the average of the four marks.

45. Drawing. Our knowledge of the drawing ability of the subjects (except those of the academy group) is based in part upon statements of teachers and supervisors who have had intimate acquaintance with their work, and in part upon certain work which they have done for us—particularly the results of two drawing tests. One of the tests was the drawing of a horse from memory, and the other was the drawing of a little wooden cart from the object. Five minutes were allowed for each drawing, and the subject was informed when three minutes had gone. The drawings produced were marked independently by four judges.[24] The marks were assigned on the basis of the Thorndike scale. The final score is the average of the four marks.

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[23]The judges were Miss Frances Mapel, Miss Margaret Doherty, Miss Genevieve Coy, and the author.

[24]The judges were Miss Harriett Berninger, Miss Dora Keen, Miss Frances Mapel, and Miss Margaret Doherty, advanced students in Education at the University of Illinois.

Chapter V

RESULTS OF TESTS

General Considerations

In presenting the numerical results of the tests it is desirable to indicate not only the score of an individual as expressed in the units peculiar to the test, but also his standing with reference to a large number of individuals with whom the person tested is fairly comparable. In this particular study it is further desirable that the persons who are talented in drawing be compared with others who have not such talent or at least with persons who have no more talent for drawing than would be expected in an unselected group. In the interpretation of individual scores a comparative representation of the scores is more important than the scores themselves. It is more important, for example, to know that a given individual is exceeded in general intelligence by only ten persons in a hundred of the general population than merely to know that his intelligence quotient is 115. Such is the ideal method of representation, and it is to be regretted that the comparative data available for this study are not sufficient for executing the plan in all the results. We have tried, however, to utilize the data that were at hand, and we have even gone aside from the individual study with which we started in order to supply certain others. It must be understood that the comparative data which we present are not submitted for "standards" in the various tests. Furthermore, our use of "approximate percentiles" of distribution, will not be thought unwarranted when it is considered that

the limitations of the data are understood and that we are interested in setting forth a method as well as in giving actual results.

In this chapter will be included both the results of the tests upon the subjects and the general scores with which they are compared. It has been possible in some cases to indicate roughly the percentile which the individual score represents in a comparative distribution. In other instances the background available has been less extensive, and the standing of the individual with reference to the median or average is represented. Finally, there are some tests in which the members of the test group are compared only with each other.

The results will be presented in three sections: (1) the academy group, (2) the laboratory and miscellaneous group, and (3) the elementary group. Explanations of the scores, the methods of representation, and other details of the presentation will be cumulative, and many of them may be omitted or abbreviated in the later sections.

The numbers of the tests in the several tables are the same as those given in Chapter IV.

I. The Academy Group

As explained in Chapter III, *S7* and *S8* are members of a group of 32 cadets to whom a number of different tests were given. It is possible, therefore, to compare the performances of *S7* and *S8* with those of the other members of the group. For this comparison we have chosen the 30 highest scores in each test, the results of which we are reproducing. (In a few cases one or two of the 32 scores were rejected or were missing on account of the tests being incomplete, or for other reason.) A

tabulation of scores was then made by taking the score third from the poorest (Rank 28) and every third score following, up to that of the person ranking fourth in the given test. These scores we have called "approximate percentiles." They are exhibited in Table 1. They furnish a convenient background for a rough representation of the standing of our two subjects in the various tests. Later also some of these distributions will be used for a comparison with scores of members of other groups. To find the comparative standing of a given individual score it is necessary only to find where it belongs in the distribution. Thus, if the individual score is 35 and we find that the approximate 40th percentile and 50th percentile are 34 and 36, respectively, the individual score may be represented for our purpose as lying at the 45th percentile. This means roughly that the individual score is as high as any score obtained by the 45 per cent of the subjects who stood lowest in the test.

Scores of the four tests in Table 1 which are marked with an asterisk have been "corrected to a senior basis." As mentioned previously, the cadets tested were members of different classes and differed in age. The number in the whole group, however, seemed too small to attempt a classification by classes or by ages. At the same time it seemed highly desirable to make some allowance for differences in age and advancement. For most of the tests, data for this correction were lacking, but in four of them a correction was possible on the basis of data which had come into the possession of the laboratory from a series of tests given by Dr. W. S. Miller in the Urbana High School. By means of these data, the scores of cadets in classes lower than the senior

TABLE 1

APPROXIMATE PERCENTILES OF SCORES OF 30 CADETS

Tests		Percentiles								
No.*	Name	10	20	30	40	50	60	70	80	90
2.	Word Building**	32	37	38	40	42	44	50	51	52
3.	Trabue J and K	9	11	13	15	17	17	18	19	19
4.	Winch's Story	26.7	35.2	38.3	43.3	48.2	54.0	59.3	61.5	70.0
30.	Reading Forward	109.5	96	86.5	80	77	72.5	68.8	62	61.3
31.	Reading Backward	111	123	151	167	182	204	222	242	309
5.	Opposites	467	415	395	373	344	313	301	264	237
6.	Analogies**	275	236	211	170	156	140	129	118	97
9(b)	Easy Directions	.72	.83	.91	.95	1.0	1.1	1.25	1.3	1.67
1(f)	Fables	3	6	7	7	8	9	9	10	10
10.	Proverbs	59.5	54.0	50.4	31.6	29.4	26.8	25.0	21.8	17.6
12.	Reasoning	41.5	38.1	36.3	36.0	31.8	29.5	26.8	22.6	20.3
1(g)	Code (1)	20	30	30	50	60	80	90	95	100
	(2)	65.4	50.8	40.9	31.4	23.8	18.1	15.2	14.0	11.6
19.	Marble Statue**	34	35	35	40	42	45	47	48.5	50
20.	Dutch Homestead**	30	35	41	44	47	49	49	52	59
26.	Substitution	126	135	139	143	155	159	172	177	231
28.	Mirror Drawing (R. H.)	380	246	210	193	173	140	130	85	67

*The numbers of the tests are the same as those used in Chapter IV.
**Scores corrected to senior basis.

Read the table as follows: In the *Marble Statue* test, 10% of the group (30 cadets) made a score of 34 or less; 20%, a score of 35 or less; and so on. Or, inversely, in the *Marble Statue* test the score 34 was exceeded by 90% (100-10) of the group; 35, by 80% (100-20) of the group; and so on.

class were increased to what they presumably would be, if the cadets at the time had been seniors.

The records of our subjects *S7* and *S8* in the several tests are exhibited in Table 2. Both the scores in units peculiar to each test and the approximate percentiles which these represent in the general distribution (Table 1) are presented.

TABLE 2

THE SCORES OF *S7* AND *S8* IN VARIOUS TESTS AND COMPARISONS OF THEIR SCORES WITH THE SCORES OF 30 CADETS

Tests		*S7*		*S8*	
		Score	Approximate Percentile	Score	Approximate Percentile
No.*	Name				
2.	Word Building**	42	50	45	62
3.	Trabue J and K	17	55	17	55
4.	Winch's Story	74.5	95	55.6	63
30.	Reading Forward	60	93	80	40
31.	Reading Backward	260	84	116	14
5.	Opposites	324	56	373	40
6.	Analogies C **	211	30	118	80
9(b)	Easy Directions	.95	40	.93	35
1(f)	Fables	9	65	8	50
10.	Proverbs	54	20	51	28
12.	Reasoning	37	25	49	5
1(g)	Code	20	10	100	90
19.	Marble Statue**	46	65	48.5	80
20.	Dutch Homestead**	42	33	52	80
26.	Substitution	136	23	123	7
28.	Mirror Drawing (R.H.)	204	33	210	30
	Average 16 tests		49		47

*The numbers of the tests are the same as those used in Chapter IV.
**Scores in these tests "corrected to senior basis."
The table should be read in this way: In the *Marble Statue* test, *S7* made a score of 46 (ideas reproduced). This is a score beyond which 65% of the group (30 cadets) did not go; or, inversely, this is a score exceeded by only 35% (100-65) of the group.
The data for the percentile column were obtained by a comparison of the scores with those recorded in Table 1.

II. Laboratory and Miscellaneous Groups

The first part of the numerical results of the tests which were applied to the individuals in the laboratory group and in the miscellaneous group will be presented in tabular form similar to that which has been used for

the academy group. It is desirable to compare each individual with others of similar age and advancement. In some case it has been possible to submit different backgrounds in partial satisfaction of this principle; in other cases only one background has been available for all. The array of approximate percentiles with which the individual scores are to be compared is given in Table 3. The numbers of the tests which are given below are the same as those used in the description of the tests in Chapter IV. The sources of the scores are indicated below.

(1) *Binet.* The distribution of percentiles is prepared from data given by Terman.[1]

(2) *Word Building,* (6) *Analogies,* (19) *Marble Statue,* and (32) *Cancellation of 7's.* The percentile distributions in these tests were obtained by Dr. W. S. Miller from tests given in the Urbana High School.

(3) *Trabue J and K,* (9) *Easy Directions,* (12) *Thurstone Reasoning,* (1-g) *Code* (for comparison with records of high school students), (26) *Thurstone Substitution,* and (28) *Mirror Drawing* (right hand). Data are the same as exhibited in Table 1.

(7) *Ink-Blots.* Percentiles are prepared from scores of 15 persons: our six high-school subjects and nine university students, including C1.

(8) *Pictorial Imagination.* Percentiles are based upon 16 scores. These scores were obtained from tests given to seven adults, our six high-school subjects, and C1, C4, and C5.

[1]Terman, L. M. The Measurement of Intelligence, 1916, p. 78.

(13) *Thurstone Hand.* Scores from 14 university students, including C1 and *C2,* were used for the percentiles.

(14) *Thurstone Spatial Relations.* The percentiles are based upon results from 15 university students, including C1, *C2,* and *C3.*

(16) *Painted Cube.* The scores used for the percentiles are those of 13 university students, including C1, *C2,* and *C3.*

(1-g) *Code (for college students).* Results from 12 university students, including C1, form the basis for the percentile distribution. The test was given as a group test to 10 of the persons. In the group test the code was displayed on the blackboard.

(17) *Thorndike Test of Aesthetic Appreciation.* The percentiles are based upon results from 14 university students, including C1 and *C2.* Mimeographed reproductions of the first five of Professor Thorndike's seven series were used.

(18) *Illinois Test of Aesthetic Judgment.* The percentiles are based upon the scores of 19 persons, including our six high-school subjects, and C1, *C3,* C4, and C5. One additional person of the 19 is a high-school student, and the remaining nine are adults.

(27) *Perceptual Learning.* The percentiles are based upon results from 19 members of the fortnightly conference of the Department of Education, to whom the test was given as a

group test.[2] For this purpose the smaller figures which were used in the individual testing were carefully enlarged. Care was taken in the enlargement to have the angles between lines and the relative length of lines approximately the same as in the smaller figures. The curvature of the curved lines was increased a little in order to facilitate recognition of the curvature at a distance. The time of exposure was the same as for the individual tests. We have no means of estimating the difference in performance which may be due to the giving of the test in one case by the group method and in the other by the individual method.

(33) *Rossolimo Observation.* The percentiles are based upon scores from 12 persons, including our six high-school subjects, C1, C4, C5, and three other adults.

(45) *Drawing.* The percentiles in the drawing tests are based upon results from 16 students in a class in education, to whom the tests were given as a group exercise. *C2* was a member of this class. The drawings were marked by the same four judges who marked the drawings of the members of the test groups.[3]

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[2]Through an error the simplest figure (four lines) was exposed upside down (this position was preserved in later group tests also), but, on account of the simplicity of the figure and the small change introduced, the results may still be regarded as comparable to those of the individual testing.

[3]The tests just mentioned, beginning with the ink-bolts and continuing through the list, were all given by, or under the immediate supervision of, the author—with the exception of the Illinois test of aesthetic judgment, in which case the technique is simple. This test was given to one person, whose performance is included in the values used, by Miss Florence Boehmer, and to two others by Miss Margaret Doherty.

TABLE 6

COMPARATIVE SCORES IN APPROXIMATE PERCENTILES FOR HIGH SCHOOL AND UNIVERSITY STUDENTS

No.	TESTS Name	No. Cases	PERCENTILES 10	20	30	40	50	60	70	80	90
1.	Binet I Q		85	90	94	97	100	103	106	110	115
2.	Word Building										
	High School Juniors		29	31	33	36	38	40	42	45	47
	High School Seniors		28	32	36	38	39	42	44	48	51
3.	Trabue J & K	30	9	11	13	15	17	17	18	19	19
6.	Analogies C										
	High School Juniors		17.4	16.4	13.4	12.1	11.5	10.8	9.5	8.8	8.2
	High School Seniors		16.0	13.5	11.5	10.6	10.0	9.6	8.4	7.7	6.4
7.	Ink-blots	15	8.2	7.6	7.2	6.3	5.5	5.3	5.0	4.9	4.0
8.	Pictorial Imagination	16	5.4	5.0	4.1	3.6	3.0	2.9	2.6	2.4	2.3
9.	Easy Directions	30	.72	.83	.91	.95	1.0	1.1	1.2	1.3	1.7
12.	Thurstone Reasoning	30	51	40	37	36	34	30	28	23	20
13.	Thurstone Hand	14	17	12	10	9	8	8	7	6	5
14.	Spatial Relations	15	38	28	27	26	18	16	14	13	9
16.	Painted Cube	13	280	169	114	93	65	58	54	49	43
1-g	Code										
	For High School	30	78	60	42	34	26	19	16	14	12
	For College	12	27	25	22	21	17	15	13	9	7
17.	Th. Aesthetic Appreciation	14	28	26	24	22	22	17	15	12	10
18.	Ill. Aesthetic Judgment	19	74	75	77	81	83	85	87	90	90
19.	*Marble Statue*										
	High School Juniors		31	36	37	39	41	42	44	46	49
	High School Seniors		33	37	39	40	42	44	45	48	51
26.	Thurstone Substitution	30	126	135	139	143	155	159	172	177	231
27.	Perceptual Learning	19	76	64	58	54	53	50	47	43	41
28.	Mirror Drawing R. Hand	30	380	246	210	193	173	140	130	85	67
32.	Cancellation 7's[1]										
	High School Juniors		.49	.57	.61	.65	.68	.70	.73	.79	.83
	High School Seniors		.59	.61	.64	.68	.70	.73	.77	.81	.89
33.	Rossolimo Observation	12	9.9	8.8	8.6	7.8	6.5	6.0	5.4	5.2	5.0
45.	Drawing										
	Horse	16	5.2	5.8	7.2	7.6	8.1	8.6	9.0	9.8	13.2
	Cart	16	5.2	6.6	7.1	8.6	9.1	9.8	10.5	11.4	12.5

[1]Given as a work-limit test.

The way in which the table should be read may be illustrated by test No. 3: In the Trabue Tests J and K (Number 3 in Chapter IV), approximately 10% of a group of 30 did not exceed the score 9, or, inversely, approximately 90% (100-10) made scores greater than 9; approximately 20% did not exceed the score 11; etc.

TABLE 4

SCORES OF THE LABORATORY AND MISCELLANEOUS GROUPS IN SELECTED TESTS, AND THE APPROXIMATE PERCENTILES TO WHICH THESE SCORES CORRESPOND IN THE GENERAL DISTRIBUTIONS OF TABLE 3

Tests		S1		*S2*		S3		*S4*		S5	
No.	Name	Score	Approx. Percentile	Score	Approx. Percentile	Score	Approx. Percentile	Score	Approx. Percentile	Score	Approx. Percentile
1.	Binet I Q	111	82	104	63	119	93	107	73	119	93
2.	Word Building	38	40	31	20	45	80	45	73	48	81
3.	Trabue J & K	19	85	11	20	20	92	20	92	22	95
6.	Analogies C	10.0	50	11.5	50	5.5	94	5.0	94	8.4	70
7.	Ink Blots	7.2	30	5.3	60	6.3	40	7.2	30	7.6	20
8.	Pictorial Imagination	3.0	55	2.6	70	4.0	33	1.5	95	4.1	30
9.	Easy Directions	1.4	83	1.4	83	1.4	83	1.7	90	1.8	92
12.	Thurstone Reasoning	21.7	86	48.3	12	16.5	95	22.9	80	18.8	92
13.	Thurstone Hand	5.1	89	6.1	79	5.5	85	5.1	89	3.6	95
14.	Spatial Relations	12.5	81	30.9	17	9.4	89	47.0[1]	5	14.3	70
16.	Painted Cube	22	95	144	25	20	95	60	57	50.5	77
1-g	Code	12	90	57	22	11	92	37	36	11	92
17.	Th. Aesthetic Appreciation	34	5	14	73	24	30	20	54	14	73
18.	Ill. Aesthetic Judgment	90	85	75	20	93	93	70	5	78	31
19.	Marble Statue	37	20	36	21	50	91	43	55	45	70
26.	Thurstone Substitution	234	91	199	84	260	93	178	80	282	95
27.	Perceptual Learning	33	95	28	97	38	92	34	95	18	98
28.	Mirror Drawing, R.H.	53	96	147	58	40	98	70	88	67	90
32.	Cancellation, 7's	.77	70	.78	78	.68	50	.83	83	.76	67
33.	Rossolimo Observation	6.1	58	10.2	5	7.6	41	5.5	69	5.1	88
45.	Drawing Horse	10.5	82	8.5	58	12.2	88	17.3	98	9.9	80
45.	Drawing Cart	9.4	54	10.3	67	9.9	61	13.2	94	10.4	69

[1]Subject complained of headache and inability to concentrate upon the task.

Read the table as follows: The score of S1 in the Binet tests (I. Q.) is 111. This score corresponds approximately to the 82d percentile of the distribution given in Table 3.

TABLE 4 (*Continued*)

No.	Tests Name	S6 Score	S6 Approx. Percentile	C1 Score	C1 Approx. Percentile	*C2* Score	*C2* Approx. Percentile	*C3* Score	*C3* Approx. Percentile	C4 Score	C4 Approx. Percentile	C5 Score	C5 Approx. Percentile
1.	Binet	100	50	112.5	85					101	53	110	80
2.	Word Building	42	70					34	25	42	60		
3.	Trabue J & K	21	94					16	45	17	55	17	55
6.	Analogies C	14.3	27	8.1	74			20.3	1	14.4	17	4.0	96
7.	Ink Blots	5.8	46	3.6	98								
8.	Pictorial Imagination	2.2	92	2.4	80					5.7	7	4.1	30
9.	Easy Directions	1.1	57							1.4	83	1.1	57
12.	Thurstone Reasoning	44.2	16							30.3	60	63.3	5
13.	Thurstone Hand	6.2	78	8.4	46	12.1	20	8.0	55	3.8	94	3.4	96
14.	Spatial Relations	29.3	19	8.6	90	16.9	55	26.8	32	11.0	85	7.1	93
16.	Painted Cube	116	30	56	65	64	51			52	74	114	30
1-g	Code	13	87	7.3	88					21	41	23	28
17.	Th. Aesthetic Appreciation	18	58	22	50	10	90			16	65	20	54
18.	Ill. Aesthetic Judgment	83	48	88	72			75	20	83	48	83	48
19.	Marble Statue	42	57					35	15	38	25	47	77
26.	Thurstone Substitution	182	81					190	82	209	86	168	67
27.	Perceptual Learning	41	90			31	99	52	53	46	72	40	90
28.	Mirror Drawing R. H.	91	78	75	86					126	71	78	84
32.	Cancellation 7's	.68	50							.78	73	.56	8
33.	Rossolimo Observation	4.8	93	5.3	75					8.6	30	5.0	90
45.	Drawing Horse	9.9	80	12.2[2]	87	14.2	93	11.3	84	12.4	88	11.3	84
45.	Drawing Cart	13.5	94	11.8	83	13.4	95	11.5	81	15.2	96	8.8	44

[2]Scored by two judges only.

TABLE 5

PERFORMANCES IN SELECTED TESTS OF THE BINET SERIES

	S1	*S2*	S3	*S4*	S5	S6	C1	C4	C5	Score Required for Passing: Average Adult	Score Required for Passing: Superior Adult
(a) Memory for digits											
Forward (Length of series)	8	6	8	6	9	5	7	7	7	[7][2]	8
Backward (Length of series)	5	6	9	5	8	5	6	5	7	6	7
(d) Clock test											
No. correctly solved	3	3	2[1]	3		3	2[1]	3	3	[2][2]	
Average time for solutions (in seconds)	12	10	10				2.5		16		
(e) Vocabulary (No. defined)	69	57	86.5	78.5	72	72	82	72.5	67	65	75
(f) Fables (Points allowed)	9	10	9	9	10	9	8	9	10	8	
(g) Code											
No. of Letters correct	10	3	9.5	8	11	11	11	9	10	9	
Time in seconds	120	170	103	295	120	140	80	185	225	360	
(h) Inclosed boxes (No. correct)	4	4	4	3	4	4	4	4	4	3	
(i) Paper cutting (P, pass; F, fail)	P	P	P	F	P	P	P	F	F		P
(j) Logical memory (P, pass; F, fail)	P	F	P	P	P	F	P	F	P		P

[1]Each of these persons made a rapid correction in the third response, when attention was directed to the fact that a mistake had been made.

[2]Test occurs in 14-year series.

Table 4 presents the scores of the members of the laboratory group and of the miscellaneous group, in the tests for which comparative results were given in Table 3. The representation is similar to that used in Table 2.

Total performance in the Binet tests is indicated in terms of the intelligence quotient in Table 4. In Table 5 are given the results of certain selected tests of the series. The numbering of these tests is made to conform with that used in their description in Chapter IV.

The results of the analogies test, List C, were given in Table 4. The results for Lists A, B, and C, are exhibited in Table 6.

TABLE 6

RESULTS ANALOGIES TESTS

Subjects	List A		List B		List C		Total Time	Deviation from Mean
	Time	Failures	Time	Failures	Time	Failures		
S1	3.1	0	4.5	0	10.0	3	17.6	−1.2
S2	3.4	0	6.1	2	11.5	5	21.0	−4.6
S3	2.4	0	2.5	0	5.5	1	10.4	6.4
S4	3.7	0	2.9	0	5.0	0	11.6	4.8
S5	2.8	0	3.9	0	8.4	3	15.1	1.3
S6	1.9	0	5.6	0	14.3	4	21.8	−5.4
C1					8.1	3		
C4	4.5	1	5.2	1	14.4	5	24.1	−7.7
C5	2.8	0	2.9	0	4.0	0	9.7	6.7
Mean							16.4	4.8

The time is in seconds and indicates the average time for each of 20 responses. "Failures" indicate the number of stimulus cards to which no correct response was given in 30 seconds.

Deviations are computed from the mean total time (16.4 sec.) for this group. A minus deviation indicates a performance poorer than the mean.

In Table 7 are exhibited scores in a number of tests in which we have lacked an adequate background of

TABLE 7

SCORES AND DEVIATIONS FROM THE MEAN IN SELECTED TESTS

(Deviations are written below the scores)

No.	Tests Name	S1	*S2*	S3	*S4*	S5	S6	C1	*C3*	C4	C5	Mean
3.	Trabue C, J, and K	37	25	35	34	38	36			34	30	33.6
		3.4	−8.6	1.4	.4	4.4	2.4			.4	−3.6	3.1
9–b.	Hard Directions	1.12	.72	.99	1.17	.96	.65			.63	.59	.85
		.27	−.13	.14	.32	.11	−.20			−.22	−.26	.21
23.	Memory, Lineal Figures	9	10	8	8	8	8	10		8	9	8.6[1]
		.4	1.4	−.6	−.6	−.6	−.6	1.4		−.6	.4	.7
24.	Memory, Colored Figures	10	10	9	10	10	10	10		10	10	9.7[1]
		.3	.3	−.7	.3	.3	.3	.3		.3	.3	.3
25.	Memory, Pictures	9	10	9	9	9	9	10		9	9	9.3[1]
		−.3	.7	−.3	−.3	−.3	−.3	.7		−.3	−.3	.4
32.	Cancellation, *a hlp*		2.7	3.3		3.0	3.5			3.0	5.2	3.5
			.8	.2		.5	0			.5	−1.7	.6
32.	Cancellation, *a zcy*	40	41	43	38	39	47			44	38	41
		−1	0	2	−3	−2	6			3	−3	2.5
32.	Cancellation, Triangles	1.8	1.7	1.9	1.7	1.7	1.6			1.7	1.8	1.7
		−.1	0	−.2	0	0	.1			0	−.1	
32.	Cancellation, 7	90	90	80	97	83	70			79	67	82
		8	8	−2	15	1	−12			−3	−15	8
34.	Stamp	16	19	21	11	17	20			9	15	16
		0	3	5	−5	1	4			−7	−1	3.3
35.	Spot-Pattern		5	3.4	5.4	3.6					7	4.9
			−.1	1.5	−.5	1.3					−2.1	1.1
37.	Discrimination Differences	29.5	35.5	36	32	32	29	35		37	33.5	33.1[2]
		−3.6	2.4	2.9	−1.1	−1.1	−4.1	1.9		3.9	.4	2.4
38.	Discrimination Proportions	19	17	19.5	17.5	18	16	18.5		19	17	18.3[2]
		.7	−1.3	1.2	−.8	−.3	−2.3	.2		.7	−1.3	1.0
44.	Handwriting (Ayres Scale)	51	42	46	35	66	67	61	62	44	59	53
		−2	−11	−7	−18	13	14	8	9	−9	6	9.7

The table may be read as follows: In the Trabue tests C, J, and K, (Number 3 in Chapter IV), S1 received a score of 37. The mean of the scores in the table is 33.6. The score of S1 is 3.4 better than the mean. The average deviation from the mean in these tests is 3.1.

*[1]Mean is calculated for 16 cases including the 9 above.

*[2]Mean is calculated for 13 cases including the 9 above.

*The author is indebted to Mr. Harry McKown, Miss Frances Brooks, and Miss Helen Davis for assistance in securing these comparative data.

TABLE 8

SCORES IN MOTOR TESTS AND COMPARISONS OF THESE SCORES WITH AVERAGES OR MEDIANS

	Age[1]	[42]Strength of Grip (kg.)						[39]Tapping (No. Taps in 30 Seconds)					
		Score[3]		Standard Avg. Pyle[2]		Deviations from Avg.		Score		Standard Avg. Pyle[2]		Deviations. from Avg.	
		R	L	R	L	R	L	R	L	R	L	R	L
S1	19	34.4	29.9	28.9	26.9[4]	5.5	3.0	203	163	190	180	13	−17
S2	17	50.4	44.0	44.0	42.3	6.4	1.7	211	186	198	176	13	10
S3	16	35.7	31.0	27.4	26.1	8.3	4.9	182	174	187	163	−5	13
S4	18	52.1	50.1	44.2	42.7	7.9	7.4	179	192	208	179	−29	13
S5	17	33.2	25.1	27.2	25.5	6.0	−.4	227	176	193	172	34	4
S6	18	32.0	25.0	28.0	26.3	4.0	−1.3	192	173	193	172	−1	1
C1	A[4]	37.0	28.0	28.9	26.9	8.1	1.9	184	168	190	180	−6	−12
C2	A	55.5	48.5	48.3	46.1	7.2	2.4	212	185	206	200	6	−15
C3	A			48.3	46.1			180	189	206	200	−26	−11
C4	A	28.5	28.0	28.9	26.9	−.4	1.1	190	164	190	180	0	−16
C5	A	31.0	29.1	28.9	26.9	2.1	2.2	218	192	190	180	28	12

TABLE 8 (*Continued*)

	Age[1]	[40]Steadiness (No. Contacts 15 sec.)				[41]Aiming (Deviation in 1/10 mm.)			
		Score		Deviations from Median		Score		Deviations from Median	
		R	L	R	L	R	L	R	L
S1	19	40	60	−8	0	68	76	−12	−12
S2	17	66	76	−34	−16	46	66	10	−2
S3	16	32	42	0	18	65	73	−9	−9
S4	18	57	54	−25	6	40	49	16	15
S5	17	76	74	−44	−14	49	70	7	−6
S6	18	43	68	−11	−8	64	90	−8	−26
C1	A	34	70	−2	−10	46	78	10	−14
C2	A	25	48	7	12	61	75	−5	−11
C3	A	27	36	5	24	61	59	−5	5
C4	A	90	76	−58	−16	48	50	8	14
C5	A	11	13	21	47	41	51	15	13
Third Quartile		25	38			51	59		
Median (Steadiness 9 adults, Aiming 11 adults)		32	60			56	64		
First Quartile		53	80			61	71		

[1]Ages last birthday preceding December 31, 1916.

[2]Pyle, W. H. A Manual for the Mental and Physical Examination of School Children. *University of Missouri, Bulletin,* 17: 1916, No. 24, pp. 24f.

[3]R, right hand; L, left hand.

[4]Adult.

Read the table as follows: S1, 19 years of age, made scores of 34.4 kilograms and 29.9 kilograms with the right and left hands, respectively, in the test for strength of grip (test number 42 in Chapter IV). The standard scores as given by Pyle for female adults are 28.9 and 26.9 respectively. S1's scores are 5.5 and 3.0, respectively, better than the standard scores. In the steadiness tests, S1's scores are 40 and 60 respectively. The median scores for 9 adults are 32 and 60, respectively (below body of table). The right-hand score of S1 is 8 poorer than the median, and the left-hand score is just equal to the median.

TABLE 9

SCORES IN MIRROR DRAWING AND DEVIATIONS OF THESE SCORES FROM THE MEANS OF THE GROUP

Subjects	Right Hand		Left Hand		Sum (R and L)	
	Score	Dev. from Mean	Score	Dev. from Mean	Score	Dev. from Mean
S1	53	30	37	13	90	43
S2	147	−64	92	−42	239	−106
S3	40	43	37	13	77	56
S4	70	13	40	10	110	23
S5	67	16	42	8	109	24
S6	91	−8	65	−15	156	−23
C1	75	8	51	−1	126	7
C4	126	−43	43	7	169	−36
C5	78	5	45	5	123	10
Mean	83	26	50	13	133	36

The table should be read as follows: In the mirror drawing test, S1 made scores of 53 and 37 with the right and left hands, respectively. The sum of these scores is 90. The means for the group are 83, 50, and 133, respectively. The scores of S1 are 30, 13, and 43, respectively, better than the mean scores.

TABLE 10

RESULTS, BETTS QUESTIONARY

Score represents per cent of images in each modality reported as belonging to the various degrees of vividness.

Imagery Degrees	S1	*S2*	S3	*S4*	S5	S6	*C2*	C4	C5	Betts[1]
Visual										
1	6	0	44	59	53	59	78	9	75	18
2	31	19	28	41	31	13	9	72	19	38
3	28	41	25	0	9	19	13	16	6	23
4	9	34	3	0	0	3	0	3	0	10
5	9	0	0	0	6	6	0	0	0	6
6	9	3	0	0	0	0	0	0	0	3
7	6	3	0	0	0	0	0	0	0	2
Auditory										
1	0	0	45	10	90	60	80	25	60	21
2	15	45	40	55	10	0	10	55	10	35
3	35	25	10	30	0	35	10	10	20	21
4	15	20	5	5	0	5	0	5	5	14
5	20	5	0	0	0	0	0	0	5	4
6	10	0	0	0	0	0	0	0	0	2
7	5	5	0	0	0	0	0	5	0	3
Kinaesthetic										
1	0	0	55	10	50	20	0	0	30	23
2	0	15	20	45	5	0	0	40	35	29
3	20	50	25	40	25	35	45	55	35	23
4	40	35	0	5	5	0	20	0	0	14
5	20	0	0	0	5	45	10	0	0	7
6	15	0	0	0	10	0	10	5	0	2
7	5	0	0	0	0	0	15	0	0	2

[1]34 College Seniors. Betts, G. H. *The Distribution and Function of Mental Imagery*, 1909.

comparative results. The scores of the subjects have been for the most part compared only with each other. The means of the scores and deviations from the means are indicated.

The scores in four motor tests are given in Table 8. In the case of steadiness and aiming we are able to give for comparison the first quartile, median, and third quartile of the scores made by members of a class in Mental Tests. Deviations from the median have been calculated for each individual. The standards for the tapping and strength-of-grip tests are taken from Pyle.[4]

The results of the mirror drawing test are shown in Table 9. The members of the group are compared with each other. A comparison of right-hand mirror drawing with the Culver results is made in Table 4.

The numerical results secured from the application of the Betts questionary for imagery are given in Tables 10 and 11. They are compared with the results obtained by Betts from 34 college seniors.

In addition to the results presented in the tables, the following individual scores may be presented.

The score of C1 in the "Cicero" test for logical memory is 49. This is better than any score reported for 36 college students by Whipple. (See *Manual,* page 577.)

The score of C3 in the "Dutch Homestead" test for logical memory is 23. This places him very low in the lowest ten per cent of the Culver group. (See Table 1.)

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[4]Pyle, W. H. A Manual for the Mental and Physical Examination of School Children. *University of Missouri Bulletin,* Vol. 17, 1916, No. 24, pp. 24f.

TABLE 11

VIVIDNESS OF IMAGERY

Score is sum of all partial scores 1 to 7 in answers to imagery questionary.

	S1		*S2*		S3		*S4*		S5		S6		*C2*		C4		C5		Betts	
	Score	Dev. Betts	Score	Dev. Betts	Score	Dev. Betts	Score	Dev. Betts	Score	Dev. Betts	Score	Dev. Betts	Score	Dev. Betts	Score	Dev. Betts	Score	Dev. Betts	Avg. Score	Avg. Dev.
Visual	108	*−26*	108	*−26*	60	*22*	45	*37*	56	*26*	59	*23*	43	*39*	69	13	42	*40*	82[1]	16[1]
Auditory	78	*−26*	61	−9	35	*17*	46	6	22	*30*	37	*15*	26	*26*	44	8	37	*15*	52	12
Kinaesthetic	89	*−36*	64	−11	34	*19*	48	5	48	5	70	*−17*	86	*−33*	55	−2	41	12	53	15

[1]Values given by Betts are 103 and 19.50, respectively. The values in this table were derived by taking four-fifths ($^{32}/_{40}$) of the given values. (Only 32 of Betts' 40 questions were used in this study).

The deviation is the difference between the Betts average score and the score of the individual. If it exceeds the average deviation from the average score (last column of table above) as given by Betts, it is italicized. A plus deviation indicates more vivid imagery than the average. For example, the score of S1 in visual imagery is 108. This indicates a degree of vividness 26 points less vivid than the average (82) computed from Betts' tables, and this deviation (26) is greater than the average deviation (16) of the Betts group.

III. The Elementary Group

The numerical results of the tests given to the elementary group are exhibited in a manner similar to that which has been used in the preceding sections of this chapter.

Table 12 and 13 exhibit the results of a number of tests in which it has been possible to arrange for comparison a distribution of "approximate percentiles." Results from fifth-grade children are given in Table 12, and results from sixth-grade children in Table 13. The scores for the tests where the number of cases reported exceeds 16 are those of pupils in all of the fifth and sixth grades of the Leal school. The scores for the Thorndike aesthetic appreciation test and the perceptual learning test were made by pupils in a single room, a room in which all of the pupils, with one exception, have intelligence quotients greater than 100. The scores for the code test were taken from the results of the regular Binet tests on the same group with the addition of a few children from other rooms. Percentiles for the cancellation tests are calculated from results of tests given to unselected fifth- and sixth-grade children. The perceptual learning test was given as a group test both to the experimental group and to the comparative group. Enlargements of the figures were used in the way that has been described for the laboratory group.

Table 14 presents the scores, in the tests named in Tables 12 and 13, of the elementary-school pupils who are subjects of this study. The scores are given in the units peculiar to each test and in percentiles which these scores represent in the distributions of Tables 12 and 13. In addition, the standing (in general work, in handwriting, and in drawing) of each of the subjects, in relation

TABLE 12

COMPARATIVE SCORES IN APPROXIMATE PERCENTILES FOR FIFTH GRADE

	Tests	No. Cases	Percentiles								
No.	Name		10	20	30	40	50	60	70	80	90
1.	Binet I. Q.		85	90	94	97	100	103	106	110	115
2.	Word Building	61	13	15	16	17	20	21	23	25	29
3.	Trabue, B and C	61	17	21	22	23	23	25	25	27	29
10.	Proverbs	59	296	222	192	158	144	131	118	78	67
11.	Bonser Reasoning, I, II	62	1	3	4	6	7	9	12	15	19
12.	Thurstone Reasoning	69	−9	−6	−5	−3	−1	0	2	4	5
13.	Thurstone Hand	64	−24	−19	−16	−9	−5	−1	2	6	21
14.	Spatial Relations	67	905	215	154	119	111	75	53	36	28
15.	Punched Holes	67	2	3	3	4	4	5	6	8	12
1-g	Code	13	85	53	45	42	41	31	25	23	22
17.	Th. Aesthetic Appreciation	15	37	34	30	28	26	26	22	20	16
19.	*Marble Statue*	64	22	25	27	29	30	33	35	37	40
22.	*Lincoln,* Immediate	67	18	19	20	22	23	25	26	27	29
22.	*Lincoln,* Deferred	62	13	15	16	16	17	19	20	22	25
27.	Perceptual Learning	16	68	61	59	57	54	51	50	49	42
32.	Cancellation, Triangles	14	23	28	32	33	34	36	37	41	47
32.	Cancellation, 7's	15	30	35	37	45	51	59	64	70	79
45.	Drawing, Horse	63	3.1	3.6	4.4	5.4	5.6	6.0	6.4	6.9	7.6
45.	Drawing, Cart	62	3.2	4.2	5.7	6.1	6.4	6.7	7.0	7.6	8.3

Read this table in the way that Table 3 is read.

TABLE 13

COMPARATIVE SCORES IN APPROXIMATE PERCENTILES FOR SIXTH GRADE

	Tests	No. Cases	Percentiles								
No.	Name		10	20	30	40	50	60	70	80	90
1.	Binet I. Q.		85	90	94	97	100	103	106	110	115
2.	Word Building	71	14	16	18	21	23	24	25	28	30
3.	Trabue, B and C	73	19	21	22	23	24	26	27	27	30
10.	Proverbs	67	244	176	146	124	112	101	84	68	55
11.	Bonser Reasoning, I, II	75	2	4	6	8	10	13	16	20	24
12.	Thurstone Reasoning	74	−9	−4	−1	0	1	2	3	5	7
13.	Thurstone Hand	76	−21	−12	−5	−2	2	5	8	14	17
14.	Spatial Relations	71	903	187	115	95	77	54	46	38	27
15.	Punched Holes	76	1	3	4	4	5	6	7	9	17
1-g	Code	14	100	54	48	44	33	31	28	25	22
17.	Th. Aesthetic Appreciation	16	34	32	31	29	28	26	24	22	20
19.	*Marble Statue*	75	24	27	29	31	33	34	36	39	41
22.	*Lincoln,* Immediate	76	18	20	21	23	24	25	26	27	29
22.	*Lincoln,* Deferred	69	14	15	16	17	18	21	22	23	26
27.	Perceptual Learning	16	67	64	61	52	48	41	38	35	33
32.	Cancellation, Triangles	15	32	34	35	38	38	39	41	44	47
32.	Cancellation, 7's	15	36	47	49	50	51	54	56	59	63
45.	Drawing, Horse	73	3.0	3.4	4.0	4.5	5.3	6.3	6.9	8.0	8.6
45.	Drawing, Cart	73	4.3	5.3	5.7	6.1	6.7	7.0	7.8	8.3	9.2

Read the table in the way that Table 3 is read.

to other pupils of his grade and teacher, has been reduced to a percentile basis and included in the table. The general school standing for pupils of the fifth grade is based upon the marks assigned to the pupils in spelling, reading, arithmetic, grammar or language, geography, and physiology. The basis of the school standing in the sixth grade is the same with the omission of geography and the addition of history. The marks used were the monthly marks which were available in each branch at the close of the sixth school month. Approximate medians were taken for each pupil in each subject

TABLE 14

SCORES OF THE ELEMENTARY GROUP, AND THE APPROXIMATE PERCENTILES TO WHICH THESE SCORES CORRESPOND IN THE GENERAL DISTRIBUTION OF TABLES 12 AND 13

	Tests	E1		*E2*		E3	
		Score	Approx. Percentile	Score	Approx. Percentile	Score	Approx. Percentile
1.	Binet, I. Q.	72.5	3	101.4	55	91.6	23
2.	Word Building	16	20	34	95	15	15
3.	Trabue, B and C	22	30	21	20	17	6
10.	Proverbs, I, II, VI	123	41	99	61	166	23
11.	Bonser Reasoning, I & II			2	10	0	5
12.	Thurstone Reasoning	1	50	3	70	−1	30
13.	Thurstone Hand	0	45	−6	29	14	80
14.	Thurstone Spatial Relations	900	10	133	28	33	32
15.	Punched Holes	2	15	6	60	5	50
1-g	Code	77	15	85	13	21	92
17.	Th. Aesthetic Appreciation	35	7	26	60	28	50
19.	*Marble Statue*	24	10	36	70	36	70
22.	*Lincoln & Pig,* Immediate	22	35	25	60	26	70
22.	*Lincoln & Pig,* Deferred	23	80	11	5	22	70
27.	Perceptual Learning	56	36	43	57	40	63
32.	Cancellation Triangles	41	70	44	80	44	80
32.	Cancellation 7's	66	95	49	30	67	96
45.	Drawing, Horse	8.1	82	8.9	95	10.8	99
45.	Drawing, Cart	8.1	76	9.5	93	8.6	83
	Drawing (School Marks)		97		94		100
	Handwriting (School Marks)		89		35		68
	School Standing (Marks)		5		56		5

Read the table as Table 4 is read.

TABLE 14 (*Continued*)

	Tests	E4 Score	E4 Approx. Percentile	E5 Score	E5 Approx Percentile	E6 Score	E6 Approx. Percentile
1.	Binet, I. Q.	113.5	87	93.9	30	121.0	94
2.	Word Building	12	8	13	10		
3.	Trabue, B and C	22	30	23	45	32	98
10.	Proverbs, I, II, VI	222	20	281	12	68	89
11.	Bonser Reasoning I & II	14	77	7	50	2	15
12.	Thurstone Reasoning	0	60	0	60	−8	13
13.	Thurstone Hand	−3	55	−24	10	−1	60
14.	Thurstone Spatial Relations	54	70	110	50	273	19
15.	Punched Holes	4	45	4	45	5	60
1-g	Code	29	63	(1)	0	45	30
17.	Th. Aesthetic Appreciation	26	55	30	30	28	40
19.	*Marble Statue*	29	40	35	70	42	95
22.	*Lincoln & Pig*, Immediate	18	10	20	30	22	40
22.	*Lincoln & Pig*, Deferred	15	20	15	20	19	60
27.	Perceptual Learning	45	86	95	3	63	17
32.	Cancellation Triangles	50	93	39	75	36	60
32.	Cancellation 7's	70	80	70	80	46	42
45.	Drawing, Horse	6.3	68	4.8	34	3.3	12
45.	Drawing, Cart	6.2	43	5.7	30	4.6	23
	Drawing (School Marks)		70		92		100
	Handwriting (School Marks)		21		75		75
	School Standing (Marks)		67		25		83

(1) None correct.

Read the table as Table 4 is read.

and the sum of these was used to find the relative standing of the pupil. The standing in drawing was found by comparison of the approximate medians of the marks of various pupils. In handwriting a similar method was used.

The performances of our subjects in certain selected tests of the Binet series are represented in Table 15. Along with the scores we have given the highest year in which the test is given and in which the particular score would be counted as passing. If the score given would not be counted as passing for any age in which it is given, the fact is indicated in a note.

TABLE 15

PERFORMANCES IN SELECTED TESTS OF THE BINET SERIES

Chronological Age (years and months to day of test)	E1 13–11		*E2* 11–9		E3 13–5		*E4* 11–1		E5 10–11		E6 11–6	
	Score	Yr. Pass	Score	Yr. Pass	Score	Yr. Pass	Score	Yr. Pass	Score	Yr. Pass	Score	Yr. Pass
(a) Memory for digits												
(1) Forward (Length of series)	5	7	5	7	6	10	6	10			7	14
(2) Backward (Length of series)	4	9	4	9	5	12	4	9	4	9	4	9
(b) Designs (No. credited)	1.5	10	2	10	2	10	2	10	1	(1)	1.5	10
(c) No. words given in 3 minutes	55	(2)	48	(2)	66	10	65	10	60	10	96	10
(d) Clock test									(5)			
No. correctly solved	0	(3)	1	(3)	0	(3)	1	(3)	0	(3)	1	(3)
Avg. time in seconds for correct solution			20				10				45	
(e) Vocabulary (No. defined)	32.5	10	45	12	37	10	44	12	31	10	51.5	14
(f) Fables (Points allowed)	3	(4)	6	12	5	12	4	12	3	(4)	8	16
(g) Code												
No. of letters correct	8.5	(6)	3	(6)	10	16	9	16	0	(6)	5.5	(6)
Time in seconds	657		254		212		259		260		250	

(1) Test occurs in age 10 only; a score of 1.5 is required for passing.
(2) Test occurs in age 10 only; a score of 60 is required for passing.
(3) Test is given for age 14; two correct solutions are required for passing.
(4) Below passing for lowest age (12) for which test occurs.
(5) Only two trials given.
(6) Test is given for age 16 (average adult) only; 9 correct letters in 6 minutes are required for passing.

Read the table as follows: E1 was 13 years, 11 months of age on the day of the test. Her score in (a) the test of memory for digits repeated forward is 5. Seven is the highest of the years, for which the test is listed, in which this score would be counted *passing*.

TABLE 16

SCORES IN VARIOUS TESTS AND DEVIATIONS OF THESE SCORES FROM THE MEAN
(Deviations from mean are written below the scores)

No.	Tests Name	E1	*E2*	E3	*E4*	E5	E6	Mean
7.	Ink Blots	9.2	8.9	9.6	8.3	9.8	7.0	8.8
		−.4	−.1	−.8	.5	−1.0	1.8	.8
8.	Pictorial Imagination	6.2	6.6	4.2	3.1	8.0	7.3	5.9
		−.3	−.7	1.7	2.8	−2.1	−1.4	1.5
23.	Memory, Lineal Figures	6	6	6	8	8	6	6.7
		−.7	−.7	−.7	1.3	1.3	−.7	.9
24.	Memory, Colored Figures	9	10	9	7	8	9	8.7
		.3	1.3	.3	−1.7	−.7	.3	.8
25.	Memory, Pictures	6	8	9	9	8	10	8.3
		−2.3	−.3	.7	.7	−.3	1.7	1.0
32.	Cancellation, *a hpl*	8.2	36.6	6.9	7.1	38.1	13.9	18.5
		10.3	−18.1	11.6	11.4	−19.6	4.6	12.6
32.	Cancellation, *a zcy*	25	24	37	32	28	21	28
		−3	−4	9	4	0	−7	4.5
32.	Cancellation, Triangles	2.9	2.2	2.0	2.4	3.1	3.3	2.7
		−.2	.5	.7	.3	−.4	−.6	.5
32.	Cancellation, 7	66	49	67	70	70	46	61
		5	−12	6	9	9	−15	9
34.	Stamp	6	10	10		6	8	8
		−2	2	2		−2	0	1.3
33.	Rossolimo Observation	11.0	7.8	7.6	8.7	12.2	11.0	9.7
		−1.3	1.9	2.1	1.0	−2.5	−1.3	1.7
37.	Discrimination Differences	32	33.5	32.5	30.5	30.5	28	31.2
		.8	2.3	1.3	−.7	−.7	−3.2	1.5
44.	Handwriting (Ayres Scale)	47		54	46	37	53	47
		0		7	−1	−10	6	4
18.	Ill. Aesthetic Judgment	65	65	74	50	68	68	65
		0	0	9	−15	3	3	5

Read the table in the way that Table 7 is read.

In Table 16 are given the scores in several tests, together with the mean for the six scores and the deviation of each from the mean.

The scores in six motor tests are exhibited in Tables 17 and 18. In the first of these the scores in strength of grip, speed of tapping, and weight are compared with standard averages as given by Pyle.[5] The second table contains scores of steadiness, aiming, and mirror drawing. The scores from the first tests of steadiness are compared with other scores taken under similar circumstances. These scores were taken at the Leal school following a test for rate of tapping. The scores in the second test for steadiness were taken in the laboratory of the University and were not preceded by a test for rate of tapping. Since they are markedly less than the scores in the first test, it was thought best to exhibit the two separately. (The difference in the two scores may be attributed in part to a better adjustment in the second case to the conditions of the test. It is known, for example, that *E2,* whose performance in the first test was poorest of all and in the second test considerably better than the average, was greatly scared at the time of the first test. His fright was so noticeable that he was allowed to rest a while before the record was taken. A second cause for the difference may be the fact that a test for rate of tapping had just preceded the test for steadiness by a small interval in the first case and had not in the second.) The performances in the second test for steadiness, and the aiming and mirror drawing tests are compared with the mean for the test group.

[5] *Op. cit.* p. 23.

TABLE 17

SCORES IN MOTOR TESTS AND COMPARISONS OF THESE SCORES WITH PYLE'S AVERAGES[2]

Grade[3]	Age[4]	[42]Strength of Grip (kg.)						[39]Tapping (No. Taps in 30 Seconds)						[43]Weight (in Pounds)		
		Score		Standard Avg. (Pyle)		Deviations from Avg.		Score		Standard Avg. (Pyle)		Deviations from Avg.		Score	Standard Avg. (Pyle)	Deviations from Avg.
		R	L	R	L	R	L	R	L	R	L	R	L			
E1 6	13	23.0	18.0	22.7	21.7	.3	−3.7	154	130	172	151	−18	−21	95.0	96.0	−1
[1]*E2* 6	11	23.0	23.0	19.2	18.0	3.8	5.0	153	144	163	136	−10	8	75.5	75.9	−.4
E3 6	13	34.5	30.5	22.7	21.7	11.8	8.7	166	129	172	151	−6	−22	115.0	96.0	19
E4 5	10	25.0	24.0	16.7	15.4	8.3	8.6	159	131	152	131	7	0	114.9	67.5	47.4
E5 5	10	18.5	18.5	14.3	13.4	4.2	5.1	157	125	154	133	3	−8	68.3	66.7	1.6
E6 5	11	11.5	10.5	16.3	15.6	−4.8	−5.1	190	153	163	141	33	12	61.4	76.4	−15.0

[1]Left-handed pupil, right-hand scores are recorded in left-hand column and vice versa.
[2]Pyle, W. H. *Manual for Mental and Physical Examination of School Children.*
[3]The school grade to which the pupil belongs.
[4]Age last birthday preceding December 31, 1916.

Read the table in the way that Table 8 is read.

TABLE 18

SCORES IN MOTOR TESTS AND COMPARISON OF THESE SCORES WITH MEAN SCORES

	Grade	Age	[40]Steadiness (First Trial) (No. contacts in 15 sec., 7 + 8) Score		Mean		Deviation from Mean		Steadiness (Second Trial) (No. contacts in 15 sec., 7 + 8) Score		Deviation from Mean	
			R	L	R	L	R	L	R	L	R	L
E1	6	13	108	116	97	114[3]	−11	−2	95	104	−29	−29
[1]*E2*	6	11	140	150	92	115[4]	−48	−35	47	40	19	35
E3	6	13	98	91	97	114[3]	−1	23	55	50	11	25
E4	5	10	126	126	92	115[4]	−34	−11	100	102	−34	−27
E5	5	10	93	89	85	95[2]	−8	6	58	65	8	10
E6	5	11	139	142	97	114[3]	−42	−28	43	87	23	−12
Mean[5]									66	75		

[1]Left-handed. The scores for his right hand are given in the "left" column; left in "right."
[2]Mean of scores of 10 girls, age 10 last birthday.
[3]Mean of scores of 8 girls, ages 11 and 12 last birthday.
[4]Mean of scores of 9 boys, ages 10 and 11 last birthday.
[5]Mean of scores in this table.

Read the table as Table 8 is read, substituting *mean* for *median*.

TABLE 18 (*Continued*)

	Grade	Age	[41]Aiming (Deviation in 1/10 mm.) Score		Deviation from Mean		[28]Mirror Drawing (No. of seconds) Score		Deviation from Mean		Score	Deviation from Mean
			R	L	R	L	R	L	R	L	R+L	R+L
E1	6	13	48	57	15	23	575	228	−273	−115	803	−388
[1]*E2*	6	11	52	69	11	11	120	83	182	30	203	212
E3	6	13	51	77	12	3	537	102	−235	11	639	−224
E4	5	10	81	111	−18	−31	240	126	62	−13	366	49
E5	5	10	62	111	1	−31	145	43[6]	157	70	188	227
E6	5	11	82	57	−19	23	195	94	107	19	289	126
Mean[5]			63	80			302	113			415	

[1]Left-handed. The scores for his right hand are given in the "left" column; left in "right."
[5]Mean of scores in this table.
[6]Approximate.

Read the table as Table 8 is read, substituting *mean* for *median*.

Chapter VI.

PROFILES AND PERSONAL DATA

General Discussion

Up to this point in the discussion, we have been concerned (1) with giving a general introduction to the problem of the research, (2) with explaining the nature and sources of our data, (3) with describing the experimental work which we have done, and (4) with presenting in condensed tabular form the numerical results of the experimental study. In this chapter we shall present 'profiles'[1] showing the performance of each subject in the several tests, the results of which lend themselves most readily to this type of treatment, and additional data gathered from supervisors and teachers of drawing, from parents, and from other persons. Then, at the close of the chapter, we shall bring together in a single table the most important facts (experimental and non-experimental) that we have gathered concerning all of our subjects.

Figures 1 to 13, inclusive, exhibit graphically the results recorded in Tables 2, 4, 8, and 14, and parts of Tables 17 and 18. Additional data concerning each subject are presented under a separate heading for each individual. The order in which the individuals are discussed is the same as that used in the presentation of the numerical results.

[1]For the use of the term *profile*, see the following: Rossolimo, G. Die psychologischen Profile. *Klinik für psychische und nervöse Krankheiten*, 6: 1911, Heft 3; Claparede, Ed. Profils psychologiques. *Archives de psychologie*, 16, 1916, 70ff.

S7

S7 is 19 years of age.[2] His father is a physician. His mother is "an artist, her father an architect, and her mother a natural designer." His paternal grandfather is "quite mechanically inclined." The young man's interest in drawing dates from his very early childhood, the age of three or four years. His only training in drawing, aside from the regular school work, has been a correspondence course which was only partially completed. This course was given up when he entered the Academy. At the age of 17 he did some drawing for a high-school journal. He is most interested in cartooning or illustrating and states that he intends to become a cartoonist. Trouble with his eyes has delayed his school progress. The study of mathematics has given him some difficulty. He is interested in music and plays a saxophone. The consulting psychologist of the Academy characterizes him as "distinctly of the artistic type."

S8

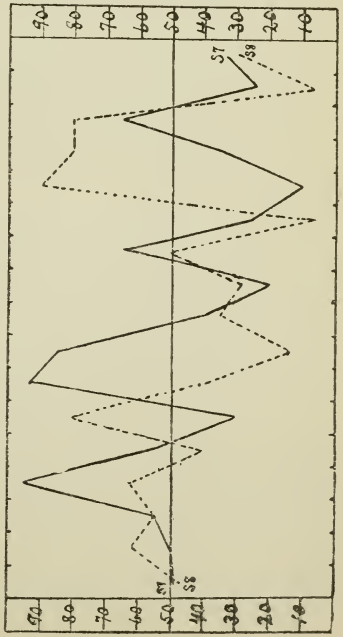
S8 is 15 years, three months of age. His father is an artist (mural decorator) of some distinction. His mother, also, is an artist of ability. Some years ago she was awarded a prize by the National Academy of Design for the most important work in American art for that year. *S8* likes to draw and "draws with ability along lines of his interest, i.e., birds, flowers, etc." He thinks that he does not want to become an artist, however, not because of any dislike for the work, but because "*artists are not much in demand,*" as he put it! In line with

[2]The ages given in this chapter are calculated to December 31, 1916.

what seems to be his innate tendency toward art, he has had some intention to become an architect, but finds himself poor in mathematics. He is near the foot of the class in algebra, but stands at the head in French and near the head in Latin. He is not interested in athletic games but likes hunting, tramping, and swimming. The Consulting Psychologist of the Academy characterizes him as "distinctly of the artistic type," and says that *S7* has "probably more actual ability in draftsmanship" but that *S8* has "more artistic appreciation."

FIGURE 1. Profiles of *S7* and *S8*.

(Based upon approximate percentiles of Table 2)



S1

S1 completed her high-school course within the school year 1916-17. Her age calculated to December 31, 1916, is 19 years, 8 months. She is classed by the supervisor of drawing as one of the best of about 75 students who have been in her classes during the present school year. Only two have been given higher marks by the supervisor in all her experience. She is characterized by the supervisor as very neat and careful, very good in color combinations, good in object drawing, particularly good in aesthetic judgment, and original. The technique has offered no particular difficulties. She is persistent in her work and would undoubtedly have a promising future if she would continue her art study.

Nearly all of the immediate relatives of S1 are farmers. Except for one sister who showed some special aptitude for drawing in high school, she knows of none of her immediate relatives who have been especially good in drawing.

The first special interest in drawing which S1 can remember goes back about to the time when she was in the sixth grade of the common schools. As far back, however, as she can remember she has always drawn pictures. Upon entering the high school she wished to take up drawing at once, but it would not fit into her program. From the second year in the high school she pursued a business course and did not take the art courses until the beginning of the third year. The only training, then, which she has had is what was obtained in the regular work of the grade schools and in two semesters of regular high-school courses. She seems not to have had enough training to develop very special interests.

The average of 39 semester grades of S1 including all subjects taken is 83 (75 is passing). In five semesters of Latin she received very low grades, but a very high grade in one semester of German. Other grades need no particular comment.

She has taken a few lessons on the piano. She is interested in out-of-door sports and appears to be normal in emotional characteristics.

S2

S2 is a high-school junior of the age of 17 years, two months. He stands about second in drawing ability in the Urbana High School according to the estimate of the supervisor of drawing.

His father is a mathematician, but has drawn illustrations for books. Practically all of his mother's people are architects; indeed, her father is a professor of architecture. His only brother is a student in civil engineering.

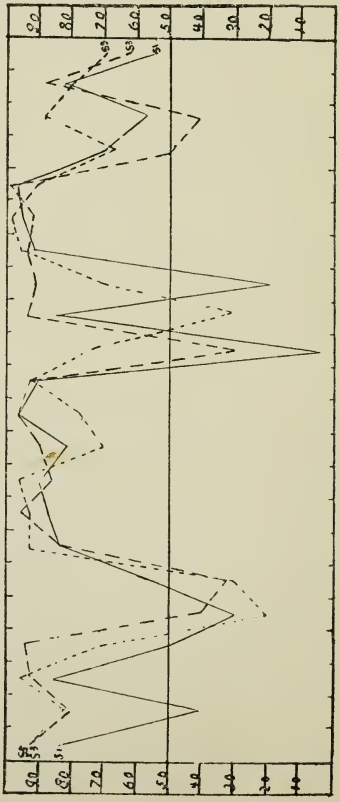
S2 was born in this country, of Swiss parentage. The first language he learned to speak was English. Before school age, however, he began to speak a Swiss-German dialect, and upon entering school in Switzerland took up the study of German in the first grade. Upon returning to the United States about five years ago, he began again to speak English.

His first memory of interest in drawing goes back to map drawing in the Swiss schools. After a while it seemed to him that particularly in water-color drawing, he did not succeed as well as others in the schools, and he rather lost interest in drawing on that account. Even to this time he does not like water-color drawing. He

was yet in the grade schools when he returned to this country. His interest in drawing was revived when he found that he could draw better than the pupils in American schools. His training in drawing consists of what he received in the grade schools and a year of high-

FIGURE 2. Profiles of S1, S3, and S5.

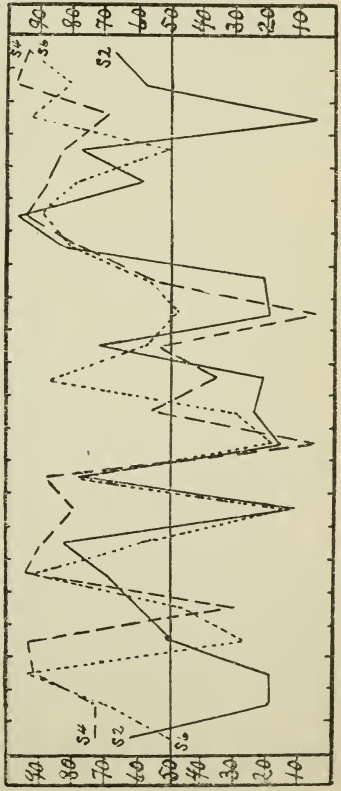
(Based upon approximate percentiles of Table 4)



school drawing, which embraced both free-hand and mechanical work. He has done practical work in illustrating, some of which has appeared in the Denver *Post*, and some of which will appear in the high-school annual. He likes decorative drawing, but dislikes mechanical

FIGURE 3. Profiles of *S2*, *S4*, and S6.

(Based upon approximate percentiles of Table 4)



drawing. His training has been too limited as yet for the development of very special interests. He wants to become an artist and would like to go into pure art. On the other hand, for financial reasons he may go into illustrating and commercial work.

Of other school subjects he likes history, literature (but not the kind which is taught in school, as he said) botany and zoology. Mathematics, foreign language, physics, and chemistry, he dislikes. The average of 20 semester grades, not including drawing, is 82.

He plays the piano and guitar, but does not sing. He is interested in out-of-door life and athletics, but he does not take part in school athletics.

S3

S3 is a junior in the high school. Her age is 16 years, 9 months. She is ranked by the supervisor of drawing as the best in the Urbana High School. Her work shows originality as well as ability in technique.

There are no artists among her immediate relatives. Her father is a distinguished physicist and illustrates his own articles (mechanical drawing). A three-year-old sister has begun to draw and a brother and sister in the grade schools draw well.

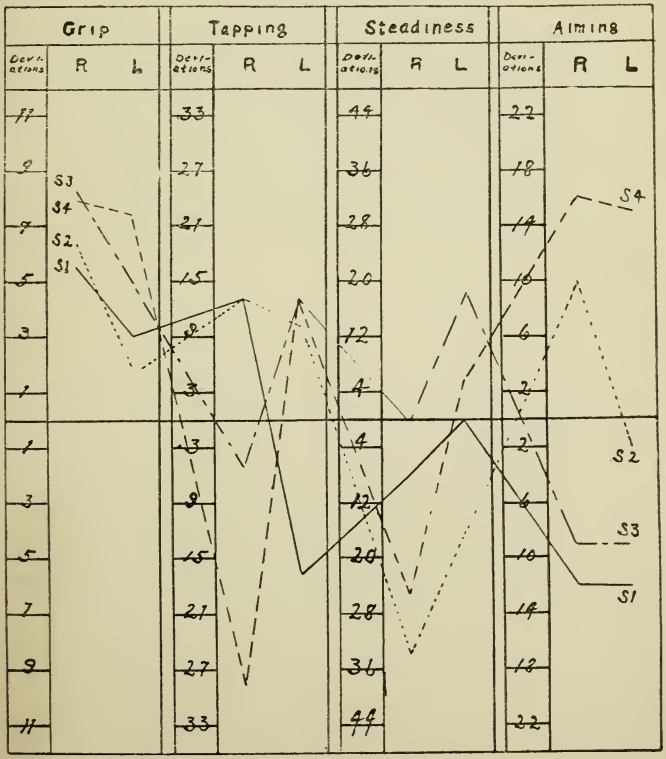
As far as her memory goes, she has always liked drawing. In the first grade she was very fond of drawing faces on the blackboard. She has had drawing instruction all through the grades of the elementary school and two years in the high school. None of this has been mechanical drawing. The development of technique has been comparatively easy. Two or three years ago her interest was greatly stimulated by a visit to an artist's studio. From that time the possibility of becoming an

artist seemed to her more attainable. She has done a little practical work such as illustrating for a high-school annual and drawing posters.

Her rank in other subjects is very high. The average of 20 semester grades, not including drawing, is 94. She has a great fondness for reading and will of her own

FIGURE 4. Deviations from Averages in Motor Tests, Subjects S1, *S2*, S3, and *S4*.

(See Table 8 for numerical data)



initiative pursue some subject, perhaps in an encyclopedia, for a whole evening. Music also interests her. She is able to play difficult music on the piano. Her outside interests and emotional characteristics appear to be normal.

S4

S4 is a high-school senior of exceptional drawing ability. His age is 18 years, eight months. With S5 he stands about third in drawing in the Urbana High School.

S4's father is a physician of high standing. His mother has drawn some, but neither his father nor his mother has developed any special interest in art. Among his immediate relatives there are no artists. Two aunts and an uncle on his mother's side have drawn to some extent, as a side interest. A brother in the first year of the high school shows rather exceptional talent in drawing.

His first interest in drawing began before he had entered school. At times he would tease his smaller brother by drawing trains and explaining that his folks were going away on them. He has had drawing instruction through the grades and for two years in the high school. None of this has been mechanical drawing, except that incidentally given in the free-hand course. When he was in about the fourth grade, however, an engineering student gave him some assistance in mechanical drawing and stimulated his endeavor by grading his attempts. The development of technique in drawing has been easy. Most of his work has been with pencil. He has had a special interest in drawing things of a military and naval character and enjoys drawing from

imagination more than from model. In such spontaneous drawings he usually draws as if from a distance in order that details may not show. He has thought of going into architecture, but is deterred somewhat by the thought that he is not good in mathematics.

Of his other subjects he likes history, literature, German, and science, but does not like mathematics particularly well. He plays the violin and sings. The average of 29 semester grades, not including drawing, is 87. In other directions his interests appear to be normal.

He has a kind of ambidexterity which should be described. He uses the left hand for coarse work such as throwing, striking, using a hammer, and the like. At the same time he does fine work with his right hand, such, for example, as carving with a penknife, or writing, or drawing. Each of his hands seems to be naturally fitted for the type of work to which he devotes them. He can not remember of ever having changed from the left hand to the right in writing.

S5

S5 is a high-school senior of the age of 17 years, 6 months. With S4 she ranks about third in drawing ability of the students of the Urbana High School.

There are no artists among her near relatives. In his lifetime her father, however, was a maker of tinsmith's patterns, and his twin brother "can draw anything," notwithstanding the fact that he has had no lessons in drawing. Her only brother, an adult, does not draw.

Although S5 remembers that she could write before entering school, she remembers no drawing previous to that time. On the first day of school her interest was

awakened by the drawing of an apple on a slate. Since that time her interest in drawing has been steadily maintained. She has had the training in drawing which is given in the grade schools and two years of high-school drawing besides. In addition, she has done recently outside of school a little work in oil painting. The acquisition of technique has been fairly easy. She prefers to draw from model rather than from memory. Her interests have not yet developed far enough to become highly specialized. During the present year she has been doing some illustrating for the high-school annual.

Arranged in order of preference, her other high-school subjects would be distributed somewhat as follows: best of all, mathematics, then science, then literature, then German, and last history. The average of 28 semester grades, not including drawing, is 87. She plays on the piano almost any selection that she wants to play and memorizes music easily.

She is interested in active sports and seems generally normal in her development.

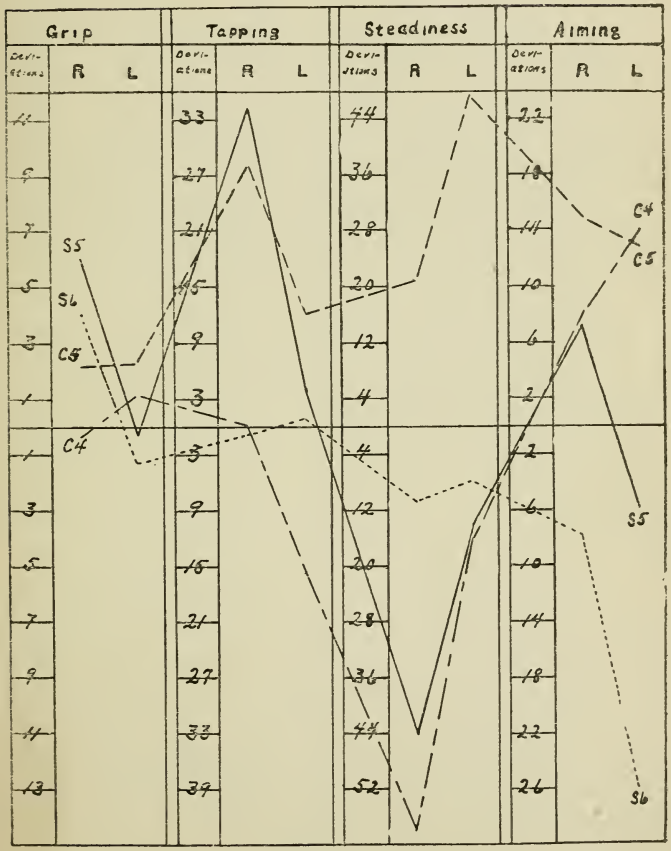
S6

S6 is a high-school junior. Her age on December 31, 1916, was 18 years, 10 months. She is considered as one of the best in about 75 students who are in the classes of the supervisor of drawing during the current year. Compared with S1, she ranks probably a little lower. Technique offers no special difficulty, and she has a good aesthetic judgment, as estimated by the supervisor. Her work shows originality.

Among the immediate relatives of S6 there are no persons who would be classed as artists. Three cousins are interested in drawing but do nothing out of the ordi-

FIGURE 5. Deviations from Averages in Motor Tests, Subjects S5, S6, C4, and C5.

(See Table 8 for numerical data)



nary in it. Her mother does not draw. Her father has had no training in drawing, but he is able to make pencil sketches of persons who can be recognized from the drawings. The occupation of her father is that of an estimator for contracting. She has no brothers or sisters.

S6's interest in drawing, as far as she can remember it, dates from about the time of her seventh year. Some one gave her a ledger in which she would make various drawings. At about the age of 11 she was one of a group of girls who became interested in drawing the "Gibson pictures." After this interest had become less intense, she seemed to lose much of her interest in drawing until she entered the high school. She has had the usual training in drawing through the grades of the common schools, except that no drawing was given in the fifth and sixth graeds of the school which she was then attending. While in the seventh grade she did a little work in oil painting outside of school. In the high school she is completing her second year of drawing. In addition to this work she has taken lessons outside of school in China painting for about a year and a half.

Her experience has not been wide enough and long enough to enable her to state her dominant interest in drawing. Just now, because of her school work in that direction, she has a strong interest in design. She prefers to draw from model rather than from memory.

In her general school work she has received an average semester grade of 85. She dislikes Latin and mathematics and has not succeeded very well with them. Her grades in German are much better.

She is interested in music and plays the piano, but her piano training has not gone very far. She likes out-

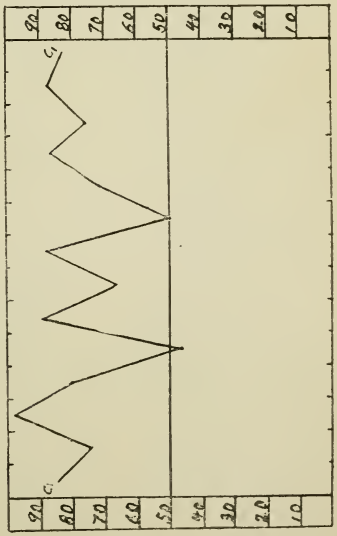
of-door sports and appears to lead a normal emotional life.

C1

C1 is a senior in the College of Liberal Arts and Sciences. We are unable to report with certainty upon the extent of her talent for drawing. It will be observed that both of her drawings made in the course of these tests rank considerably above the average. This may be significant in view of the small training which she has had. She likes to draw, but she has had no special training in drawing since the fourth or fifth grades of the common schools.

FIGURE 6. Profile of C1.

(Based upon approximate percentiles of Table 4)

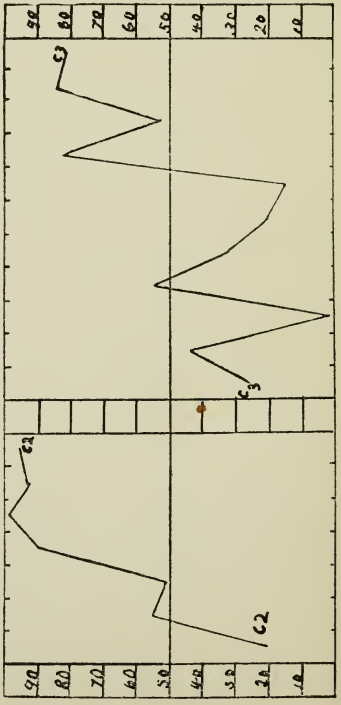


There are no artists among her immediate relatives. Her father, a lawyer, draws to some extent, but has not developed his interest very far. She has no brothers or sisters, except a half-brother of seven years who seems to draw with some promise.

Her first interest in drawing, as far as she can remember, goes back to her childhood, when her father

FIGURE 7. Profiles of *C2* and *C3*.

(Based upon approximate percentiles of Table 4)

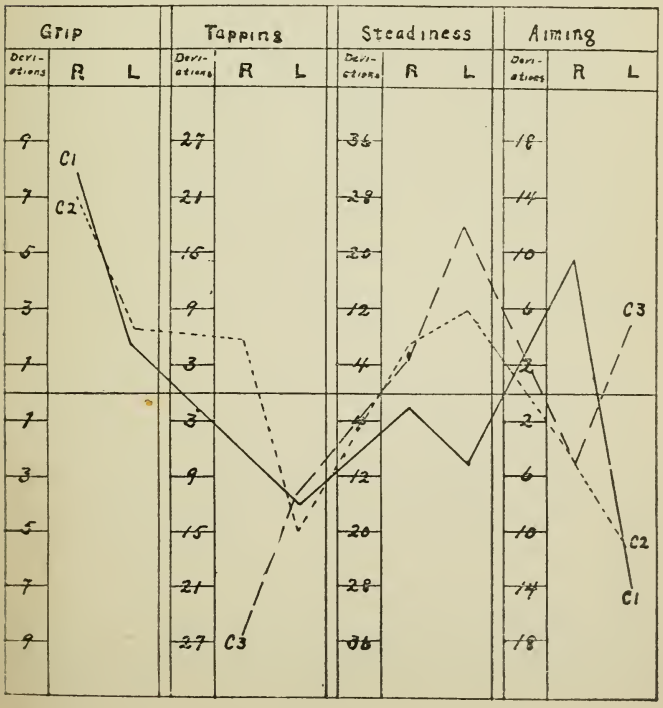


was accustomed to make drawings to amuse her. She likes to draw now and enjoys landscape drawing better than any other.

She is interested in music and has developed her talent in this more than in drawing. She plays the piano with some skill and sings also.

FIGURE 8. Deviations from Averages in Motor Tests, Subjects C1, *C2*, and *C3*.

(See Table 8 for numerical data)



C2

C2 is a graduate student in education. The development of his interest and ability appears to indicate a native talent for drawing. He has drawn ever since he can remember, and has always enjoyed it. His earliest memory of drawing is that of drawing animals. In these childish drawings he was encouraged by his father. In the elementary and secondary schools he had no instruction in drawing outside of the regular subjects,—the drawing, for example, which is incidental to botany. At the age of about 12 or 13, he had a strong desire to become a cartoonist and took a course in cartooning for about three months. During the high period of this interest, he took much delight in drawing pictures of the political characters of the day. He has practiced picking out characteristic physical features of the persons with whom he comes into contact. In college, along with his other work, he studied drawing for two years. As far as he knows, there are no artists among his relatives.

Questions supplementary to the Betts questionary (Test 29) revealed some interesting facts which may be noted here. *C2* reports that the act of drawing an object is for him a matter of *tracing* lines which stand out in the object *as these appear on the page.* People are remembered by their faces and features more than by their names. When a word like *law* is mentioned to him, the visual representation of a court scene appears to him.

C3

Apparently, *C3* represents a type of person who has native ability in drawing, the development of which is limited by rather low intellectual power. He is a soph-

omore in the College of Liberal Arts and Sciences. His college record has been generally very poor. Even in *art* courses in which he is registered, he stands comparatively very low, despite the fact that apparently he is making an earnest effort. He appears to be unable to profit rapidly by the suggestions which are given him for the improvement of his technique. On the other hand, his parentage, his interest, the results of the tests in drawing which we gave, and certain supplementary drawings which we have seen him do, argue that he has probably some native talent for drawing.

He can not remember his first interest in drawing. In school he decorated his text-books with drawings, cartoons and pictures. In the grade schools he had the ordinary instruction and in the high school had one year of drawing, a combination of both free-hand and mechanical drawing. Since that time he has had no regular instruction, except that which he has received in the college courses in which he has recently registered. He has worked for a very short time in china decorating, but has not had a great deal of practical experience in artistic expression.

His father and mother are both artists and have taken prizes in their work. His father is a china decorator.

C3 plays the piano a little and sings much more. He has had vocal lessons for three years and has done quite a little public singing.

His generally low intellectual power may probably be accounted for by a severe attack of typhoid fever and spinal meningitis combined when he was about nine years of age, and by a hard blow which he received on the back of the head at about 12 years of age. It seems

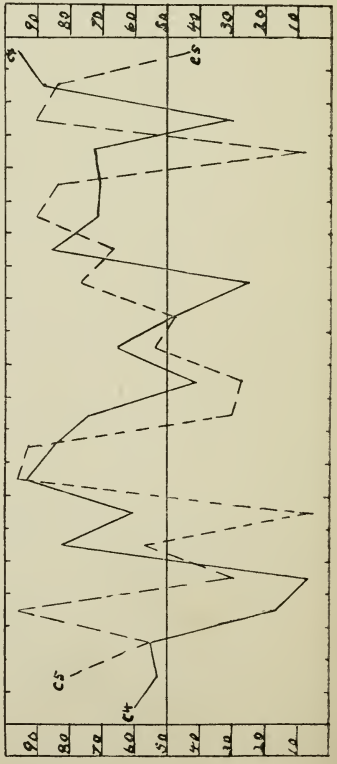
probable, then, that we have here original talent obscured by later adverse general developments.

C4

C4 is a college senior in household science. She is one of two students recommended from the Department

FIGURE 9. Profiles of C4 and C5.

(Based upon approximate percentiles of Table 4)



of Art and Design as "advanced students who have reached a degree of ability in technique and show originality."

There is some evidence of drawing ability among the near relatives of C4. Her mother showed ability in drawing and took some training in it in college, but she never carried the work very far. None of her brothers and sisters has had much training in drawing. One of her sisters, despite lack of training, can draw pencil portraits of her instructors, for example, which are strikingly like the model. Her father is a farmer.

C4 has "always" liked to draw. In her childhood, however, she attended a country school where the opportunities were greatly limited, and for this reason little stimulus was given to develop her ability. Even at home she received little encouragement. Her mother, even though she had herself received training in art, rather discouraged than encouraged her. The daughter's attempts at drawing received scant notice. One of the teachers in the country school would draw birds and other things such as the ornate penman of a generation ago so much enjoyed, and these drawings fascinated the child. In the high school she received no training—indeed none until she reached college, except the little incidental training which she received in the public schools. Yet through all these years she cherished the dream that some day she might have the opportunity and might accomplish something in art. In the university she has taken courses in art and design, charcoal drawing, modelling, sketching, and oil painting.

Her interests in drawing are not yet narrowly specialized. Her interests include such widely different subjects as portraits, landscapes, and mechanical draw-

ing. She likes to work with various mediums, but is particularly fond of working with clay. If she were entirely free to choose her career, it would be that of a sculptor. She finds it easier to draw from the model than from memory. In creative drawing she has not done enough work to know how she would like it.

Of her other studies she likes language, literature, mathematics, and science, but strongly dislikes history. She is interested in music and has taken vocal and piano lessons, the latter for a period of five or six years. She also plays the mandolin and violin.

C5

C5 was a senior in the College of Liberal Arts and Sciences. Like C4 she was recommended from the Department of Art and Design as one of the "advanced students who have reached a degree of ability in technique and show originality." The supervisor of art in the high school from which she was graduated states that C5 was about as good in drawing then as any pupil she has ever had.

Although the record of C5's interest and achievement in drawing apparently shows a native talent, there is little evidence of this ability in the circle of her immediate relatives. Within this circle there are no artists. It may be said, however, that her mother has "always liked art work." Her father is particularly capable in mechanical work and is a good penman. When about five years of age he made a sketch which attracted enough attention to be preserved for years. He is an electrical engineer.

As long as C5 can remember she has been interested in art. At about the age of three she would cut out

original patterns with the scissors. In the common branches she had only the regular work; she remembers no special school instruction in drawing until about the eighth grade. When about 11, she began to take lessons in oil painting. This work consisted chiefly in tracing and then working in details. All through the grades of the common school, she was in demand to go from room to room to put drawings on the board for various teachers. In the high school she had six semesters of drawing instruction, and has continued her work in college for three years. She is more highly trained than any member of our test groups.

Of the different lines of work represented in her training, she is probably most interested in representation of the human figure. She likes to work from memory rather than from model and to create various compositions. She enjoys working with various mediums. Already she has done quite a little practical work, such as commercial illustrating, portrait work, motto printing, etc. It is her plan to continue with commercial art.

In her high-school work the average of her 38 semester grades is 87. Although she got along very well with arithmetic in the grades, she found high-school mathematics more difficult, and especially was this true with geometry. Foreign languages required work, but she succeeded fairly well with them. She likes history, and finds English easy.

E1

E1 is a pupil in the sixth grade. Her age is 13 years, 10.5 months. She is, therefore, older than the average pupil of this grade. Even allowing for this fact, her

drawing teacher places her near the top of her grade in native drawing ability. Her originality is not commensurate with her ability in graphic representation; she can follow better than she can originate. She works better with water colors than with pencil, and in working with water colors she likes to work directly, rather than

FIGURE 10. Profiles of E1, *E2*, and E3.

(Based upon approximate percentiles of Table 14).

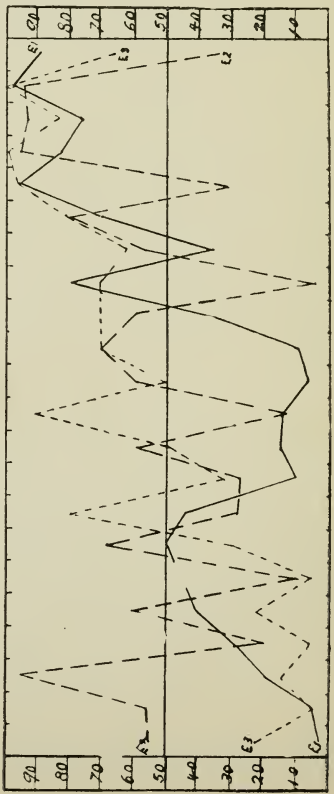
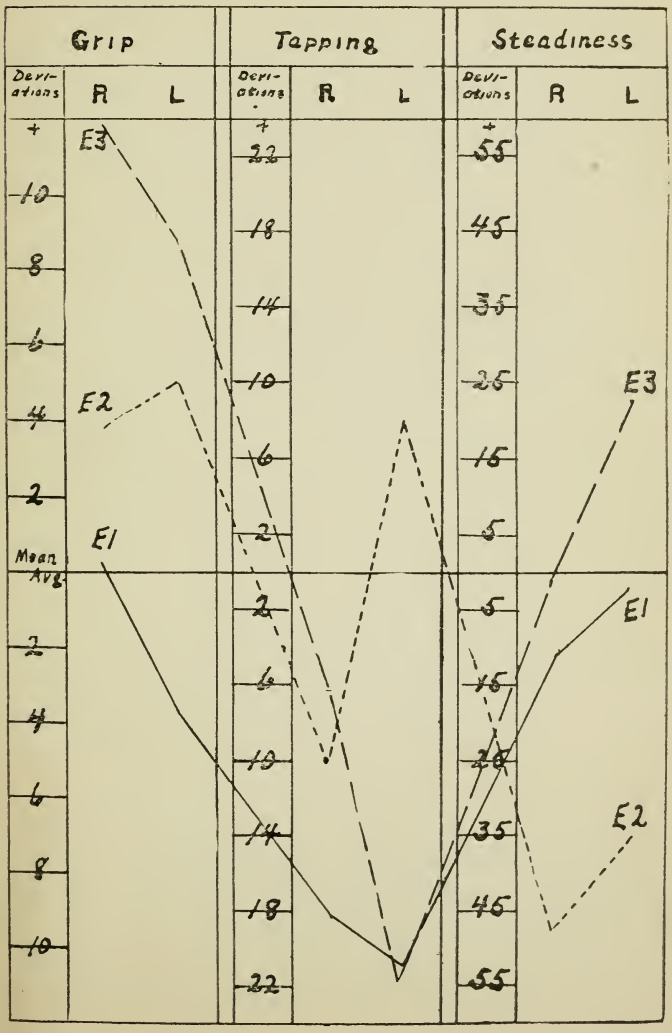


FIGURE 11. Deviations from Averages in Motor Tests, Subjects E1, *E2*, and E3.

(See Tables 17 and 18 for numerical data)



E2 is left-handed. The scores for the left hand are given in the right-hand column.

to lay out the work first with pencil and then to fill in with the color.

Apparently her talent for drawing is inherited. Her father is a tailor. He enjoys drawing and lettering. Her mother takes great interest in the children's drawings, and an aunt has made paintings of some interest. An older brother of E1 is reported as very good ("original and true") in drawing. She has also two younger sisters and a younger brother who are good in drawing.

E2

E2, age 11 years, 6 months, is a pupil of the sixth grade. He is rated by his teacher of drawing as standing near the top of his grade and school in native drawing ability. Compared with E1 and E3, other subjects in the sixth grade, he stands third. He is capable of working independently and likes imaginative drawing. He does as well with pencil work as with water-color painting. Interest and persistence characterize his work. He is left-handed.

His father is an insurance agent. His mother has painted in oil and has done some china painting. She is artistic in her home decorations and in her children's dress. A brother in the eighth grade is very good in drawing, one of the best in his grade. Two uncles are architects.

E3

E3, a pupil of the sixth grade, is 13 years, 1 month, of age. Even considering the fact that her age is greater than the average child of her grade, the teacher of drawing places her first in native drawing ability. She is original in her work and responds rapidly to suggestions for

the impovement of her drawings. She draws as well with pencil as with water color.

Her father is a policeman. Aside from the fact that the father is said to have been the best drawer in his family in his youth, the author has no information of any special ability in drawing among the relatives of E3. Her mother has been deceased for some years.

E4

E4 is a pupil of the fifth grade. His age is 10 years, 10 months. He is one of the four best in drawing in his grade and room. He works as well with pencil as with water color. He is interested in drawing and can do his work with less help than the average child of his grade. He draws little at home.

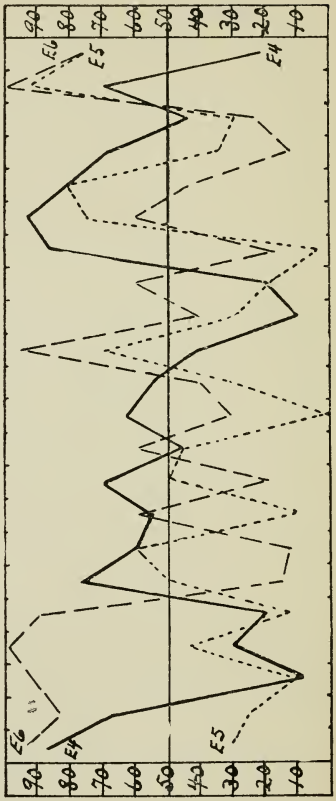
His father is a professor in horticulture, and has shown no special interest in art. His mother has worked in water color and oil painting, but exhibited no special aptitude. Her grandfather received no special training in art, but habitually decorated the flyleaves of his books with drawings. A maternal aunt of *E4*'s mother was gifted in art, as shown by her work in oil painting. A brother and sister showed more than average ability in drawing in the grades.

E5

E5 is 10 years, 9 months, of age and is a pupil of the fifth grade. She is ranked by the teacher of drawing as one of the four best of her grade and room. The quality of her work is about the same as that of E6. She does better with water color than with pencil.

There is a little evidence of special ability in drawing among her relatives. Her father is a blacksmith and

FIGURE 12. Profiles of *E4*, E5, and E6.
(Based upon approximate percentiles of Table 14)

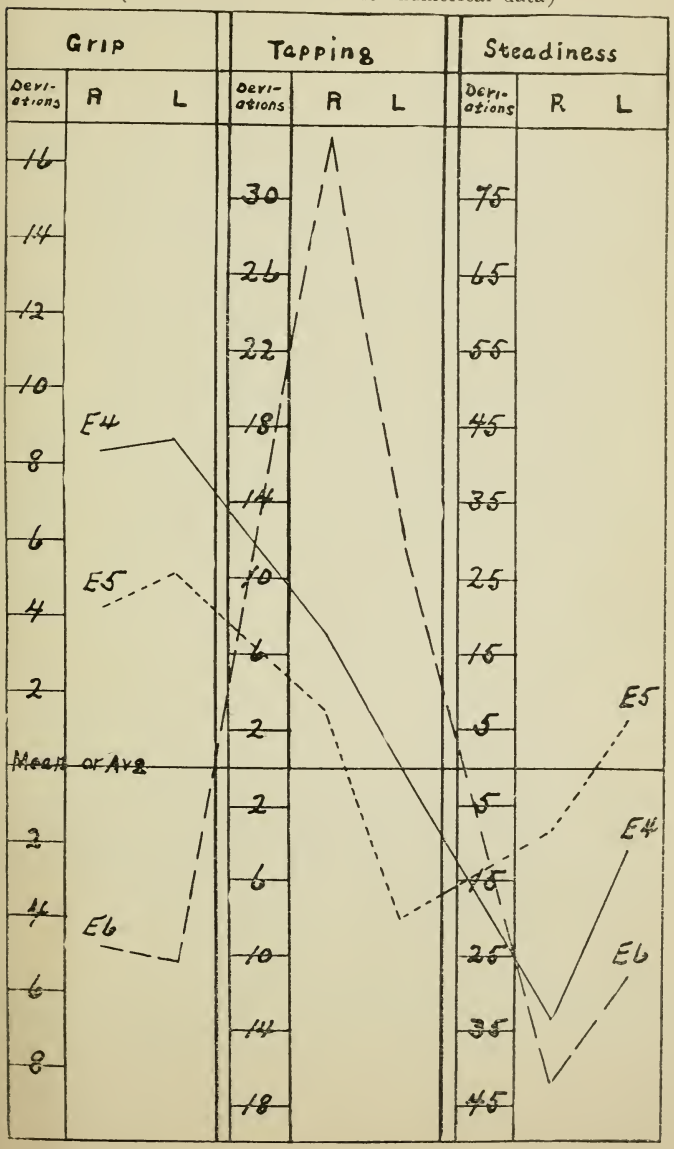


carriage maker. A cousin is a draughtsman. Her mother has not developed any special aptitude for drawing.

E6

E6 is a pupil of the fifth grade. Her age is 11 years, 3 months. Her ability ranks along with that of E5.

FIGURE 13. Deviations from Averages in Motor Tests, Subjects *E4*, E5, and E6.
(See Tables 17 and 18 for numerical data)



Both E5 and E6 are said by the drawing teacher to show less originality than *E4*. She does better work with water color than with pencil. She began to draw very early.

Her father is a concrete contractor. Her mother specialized in art and design in the university and was a successful supervisor of art instruction for some years in the public schools. She has no brothers or sisters.

Summary of Experimental and Personal Data

In Table 19 a summary is presented of many of the most important experimental and personal data. Necessarily, there has been a sacrifice of accuracy and detail, but the table has a certain value in exhibiting together a large number of facts concerning all of the subjects. Most of the headings for the experimental data have been chosen to include more than one test. When the results of the tests which are included under one heading have been contradictory, we have been able in some cases to represent the tendency of the scores in a single measure, but in others it has seemed best to indicate the difference by giving two or more measures. The designations used are *superior, average,* and *poor* (also *normal* for the test of color vision only). The *average* range, where the scores have been reduced to percentile standings, is that between the 30th and 70th percentiles, inclusive. The personal data given in the table are self-explanatory.

TABLE 19

SUMMARY OF EXPERIMENTAL AND PERSONAL DATA

Subjects	General Intelligence	Linguistic Ability	General Motor Ability	Handwriting[7]	Flexibility of Motor[8] Habit (Mirror Drawing)	Discrimination of Differences and Proportions[9]	Observation	Memory for Visual Forms	Imagery (Visual, Auditory, and Kinaesthetic)	Mental Manipulation of Spatial Forms	Invention from Graphic Forms[8]	Aesthetic Judgment	Color Vision	Drawing Tests	Drawing (Estimate of Supervisors and Teachers)
E1	P	PA	AP	S	P	A	SA	PA		AP	A	PA	N	S	S
E2	A	A	SP	A	S	S	SA	PA		PA	AS	A	N	S	S
E3	P	P	SA	A	P	A	S	SA		SA	S	A	N	S	S
E4	S	PA	SAP	P	A	A	SA	AS		A	SA	AP	N	A	S
E5	A	PA	A	S	S	A	SP	PA		PA	P	A	N	A	S
E6	S	S	SP	S	S	P	A	AP		AP	A	A	N	P	S
S1	S	SA	SAP	A	S	PA	A	S	P	S	A	PS	N	SA	S
S2	A	P	SP	P	A	SP	SP	PS	PAA	SP	A	SP	N	A	S
S3	S	S	SAP	A	S	S	A	S	S	S	A	AS	N	SA	S
S4	S	S	SP	P	S	A	SA	AS	SAA	SA	AS	AP	N	S	S
S5	S	S	SP	S	S	A	AS	S	SSA	S	PA	SA	N	SA	S
S6	A	A	AP	S	S	P	AS	S	SSP	SP	AS	A	N	S	S
S7	A	AS			A			P[1]							
S8	A	A			A			S[1]							
C1	S	S	SA	A	S	A	S[4]	S[6]		AS	S	AS		S	
C2	S?		SA					S[5]	SSP	PA		S[3]		S	
C3	P	P		A				A[3]		A		P		S	
C4	A	A	A	A	S	SA	SA	AS	A	S	P[2]	A	N	S	S
C5	S	A	S	A	S	AP	PS	LS	SSA	SA	A[2]	A	N	SA	S

[1]Code test only.
[2]Pictorial imagination test only.
[3]Thorndike test only.
[4]Rossolimo test only.
[5]Perceptual learning test only.
[6]Code and Rossolimo tests.
[7]Handwriting rank of elementary pupils based on school grades; high school students and adults are compared within group only.
[8]Elementary pupils are compared within group only.
[9]Elementary pupils: discrimination of differences only, and compared within group only.

Key to symbols: S, superior;
A, average;
P, poor;
N, normal.

Read the table as follows: E1 is poor in general intelligence. In linguistic ability the results of the tests are contradictory: in one or more tests her record is poor, and in one or more tests it is average. (Personal data are self-explanatory.)

TABLE 19 (*Continued*)

Subjects	Age (Years and Months)	School Grade	Occupation of Father	Original?	Time when Art Interest Began	Was There Period of Relative Loss of Interest?
E1	13–10	6	Tailor	Less		
E2	11– 6	6	Insurance	Yes		
E3	13– 1	6	Policeman	Yes		
E4	10–10	5	Horticulturist	Yes		
E5	10– 9	5	Blacksmith	Less		
E6	11– 3	5	Contractor	Less		
S1	19– 8	IV	Farmer	Yes	Always drawn. Special interest sixth grade	
S2	17– 2	III	Mathematician	Yes	Early in school	Yes
S3	16– 9	III	Physicist	Yes	Very early	No
S4	18– 8	IV	Physician	Yes	Very early	
S5	17– 6	IV	Patternmaker	Yes	First day of school	No
S6	18–10	III	Estimator	Yes	Age seven	Yes
S7	19	IV?	Physician		Age three or four	
S8	15– 3	I & II	Artist			
C1	Adult	Coll. 4	Lawyer		Early childhood	
C2	Adult	Col. Grad.				
C3	Adult	Coll. 2	Decorator	No		
C4	Adult	Coll. 4	Farmer	Yes	Early childhood	No
C5	Adult	Coll. 4	Electrical Engineer	Yes	Early childhood	No

TABLE 19 (*Continued*)

Subjects	Drawing Talent Among Relatives	Music: Plays or Sings
E1	Father draws and letters. Brothers and sister good is school drawing.	
E2	Mother artistic. Brother good in school drawing. Two uncles architects.	
E3	Father was best drawer in family, but is untrained.	
E4	Maternal aunt of mother very good in oil painting.	
E5	Cousin is draftsman.	
E6	Mother a former supervisor of art.	
S1	Sister showed special aptitude in high school.	
S2	Mother's people architects. Father illustrates	Yes
S3	Younger brother and sisters draw with promise.	Yes
S4	Brother, special aptitude in school. Maternal uncle and aunt draw as "side interest."	Yes
S5	Uncle draws—talent not developed	Yes
S6	Father without training but makes sketches.	Yes
S7	Mother artist.	Yes
S8	Father and mother artists.	
C1	Father draws but lacks training. Younger half-brother draws with promise.	Yes
C2	No artists among relatives.	
C3	Father and mother artists.	Yes
C4	Mother has shown some ability. Sister draws but lacks training.	Yes
C5	No artists among relatives.	

Chapter VII

THE PSYCHOPHYSICAL CHARACTERISTICS OF PERSONS TALENTED IN DRAWING

Introduction

In Chapter I we submitted, as one phase of our problem in this research, the question: *What are the essential psychophysical characteristics of persons talented in drawing?* We are now ready to bring together the results of our study and of the experimental literature in an attempt to render at least a partial answer to the question propounded.

General Discussion of Drawing

Before going to the experimental results we shall do well to get clearly in mind some of the facts concerning drawing which may be known in advance of experimental inquiry. Let us first recall what drawing is. The term *drawing* designates a process of causing, by means of pencil, pen, brush, or other instrument, certain lines or areas, or both, to appear on a given surface. If the lines and areas are intended by their similarity to some object in form, proportion, colors, or relations, to suggest that object to the observer, the drawing is *representative*. Pictures are drawings of this type. If the object represented or if the lines and areas themselves directly are used as the *sign* of some other object or idea, the drawing is *symbolic*. Drawings of the cross as a symbol of Christianity, the plus sign in mathematics, and even the letters of our alphabet are symbolic drawings. A third type of drawing is that which, without the suggestion of

any object or idea, but on the basis of the character of line, color, etc., makes immediate appeal to the aesthetic sense of the observer. *Pure designs* belong in this category. These three types may, indeed, appear in the same drawing. In fact, every drawing exists as an object with an aesthetic value in itself, quite apart from any representative or symbolic value which it may have. It is just as impossible to rob a drawing of all ideational value. The situation is made more complex by the fact that the objects or ideas suggested by the drawing may be very rich in associated ideas and feelings. A portrait of a great character, for example, has quite a different value from a portrait of an unknown person, even though the presentation may be equally forceful in each. There is, therefore, infinite possibility of variation in the intention of the drawer as to the effect which he wishes to produce, and in the character of the drawing which results from his efforts.

Our first conclusion, then, is that (1) *The production of an effective drawing includes many theoretically distinguishable activities.*

Analyses of the Ability to Draw

The following analyses of the ability to draw, taken from the literature, will serve to emphasize the complexity of the act of drawing, and will present in their context certain details of drawing talent to which reference will be made in the later discussion. The first is taken from Albien.[1] Albien found that two contrasting types were represented among his subjects. The first

[1]Albien, G. Der Anteil der nachkonstruierenden Tätigkeit des Auges und der Apperception an dem Behalten und der Wiedergabe einfacher Formen. *Zeitschrift für experimentelle Pädagogik*, 5: 1907, 133ff; 6: 1908, 1ff.

of these is the visual type. Persons belonging to this type have clear visual images of the objects to be drawn, but they vary greatly in their assimilation of the impression. With some the image is fleeting; others practice analysis and synthesis of the impression—these are the good drawers. The second type is the constructive. The visual image is less well impressed and they must rely on reflection and construction in their drawing. From the general analysis of the drawer he thinks that the cause for the lack of drawing ability may be quite different in different individuals. The following possibilities are named: (1) deficient seeing (lack of analyzing in the purely optical part and in the ideal part of the seeing); (2) indefiniteness of the visual memory image and the weakness of the visual memory in general; (3) defective guidance of the hand by the visual image; (4) too great relative strength of construction and reflection, which take the place of the visual image; (5) lack of pure motor skill, which may in turn be due in part to a defective inner control of the movements through the kinaesthetic and visual sensations.

The following analysis from Meumann[2] is stated in terms of the causes of inability to draw. These causes are as follows:

(1) The will to analyze and to note the forms and colors of things has not been aroused.

(2) The will to analyze may be present, and yet for a given individual the analysis may be difficult.

(3) The memory image may be deficient. It may have gaps or it may be dim either in form or color. The memory for spatial relations may be defective.

[2]Meumann, E. *Vorlesungen zur Einführung in die experimentelle Pädagogik*, 2d Ed., Bd. 3: 1914, p. 726.

(4) One may lack the ability to hold the memory image in attention during the act of drawing.
(5) There may be a lack of co-ordination of the visual memory image and the perceptual image with the drawing movements.
(6) The sight of the drawing and its incongruence with the memory image may disturb the latter.
(7) The drawer has not at his command various schemata such as the trained drawer has developed with which to support his drawing.
(8) One may not understand how to project three-dimensional space upon a plane.
(9) Skill of hand may be lacking.
(10) One may lack the artistic sense.
(11) The inability to draw may be due to a combination of different ones of the deficiencies above named.

Of these causes, those numbered 2, 3, 4, and 5, Meumann believes are matters of talent; the others of practice, except that number 8 is a matter both of talent and of practice.

Ayer's analysis of drawing is one of the most recent.[3] "The process of graphical expression is subject to the influence of three interrelated factors, (1) a preconceived purpose, (2) ability to see, and (3) ability to represent." The preconceived purpose varies with the individual and the occasion. Examples of purpose are the making of a visual representation and the interpretation of a scientific concept. The ability to see or "to discriminate the particular characteristics of an object which should be shown in a drawing depends upon both

[3] Ayer, F. C. *The Psychology of Drawing*, 1916, pp. 157ff.

native talent and training. A certain inherent perspicacity for, and a predisposed tendency toward, analytical observation are fundamental and peculiar to each type of drawing." Ability to represent involves various factors. (*a*) "The clearness of visual imagery, particularly in memory drawing, is of great importance to accurate representation and is subject to great individual variation." (*b*) Reflection may serve to strengthen the visual image or to substitute for it. (*c*) Drawing schemata of various common objects serve to fortify the memory. (*d*) Control of hand movements is fundamental to accurate drawing. (*e*) For the purposes of visual representation an acquired knowledge of drawing is necessary. (*f*) A final synthesis of the elements isolated during the analysis must be made in all drawing.

Variability of Psychophysical Characteristics

In the light of the foregoing discussion, it is not strange that we have found in our experimental investigation no simple formula for the constitution of drawing ability. The outstanding characteristic of the persons whom we have studied is the variability among them in their mental and physical equipment. The differences, which in studies of masses are obscured by measures of central tendencies, have been in this study of individuals brought out in bold relief.

Leaving the details of these differences for later elaboration, we may state our second conclusion in the following terms: (2) *Persons talented in drawing exhibit great individual differences in their psychophysical characteristics.*

General Intelligence and Ability in Drawing

The relation of ability in drawing to general intelligence has attracted the attention of various investigators. Kerschensteiner[4] concludes from his monumental study that: "Very great talent for graphical expression is in the case of children regularly connected with good intellectual endowment. But the statement can not be reversed." Exceptions to this rule, such as children who produce very good drawings and yet are of low general ability, seem to him only apparent. He draws a distinction between the memorial talent (*Gedächtnisbegabung*) of these children and the ideational talent (*Vorstellungsbegabung*) of really gifted children. He cites the case of a 13-year-old boy whom he had recommended for attendance at an art school as the result of what appeared to be superior performance in drawing human figures. The boy did not develop as he had thought he would in view of his previous performance. The boy, he states, seemed to have difficulty in laying hold of the *whole form* of an object. This apprehension of the total form (*Auffasung einer Gesamtvorstellung*) is deemed fundamental to real artistic talent, and it is said to be possible only in the case of good intelligence.

Kik[5] quotes with approval the statement of Kerschensteiner that great talent for graphic expression is always connected with good intellectual endowment. Before he assents to the statement, however, he defines the idea of drawing talent so as to except two types of ability. These exceptions are: (1) mechanical copying as pure manual dexterity, and (2) a one-sided talent for obser-

[4]Kerschensteiner, G. *Die Entwicklung der zeichnerischen Begabung*, 1905, 487.

[5]Kik, C. Die übernormale zeichnenbegabung bei Kindern. *Zeitschrift für angewandte Psychologie*, 2: 1908, 148.

vation developed at the expense of other mental capacities, not a capacity resting upon memory and imagination. These special abilities are not incompatible, he thinks, with low general intellectual ability.

Albien[6] found in his research no confirmation for the thesis of Kerschensteiner. Some of his subjects well-endowed in drawing ability were not of high intelligence. The boy most gifted in drawing stood 29th in average intelligence in a class of 49.

Ayer[7] found achievement in drawing "highly correlated with achievement in other school subjects, averaging nearly 70 per cent, positive. This is, no doubt, due to the fact that the standard of drawing instruction calls for a variety of mental and motor processes which are the same as, or similar to, those found in other school subjects. Ability in representative drawing [drawing reproducing the actual appearance of an object as accurately as possible] is not correlated with achievement in school subjects when it is isolated from the other factors of school drawing." The separate factors included in the drawing grades upon which this correlation is based are "(*a*) ability in representative drawing, (*b*) ability in designing, (*c*) ability in artistic discrimination, (*d*) ability with color, washes, shading, etc., (*e*) attendance, (*f*) discipline, and (*g*) vocational interest." The grades are those of 141 normal-school students.

In our own study the results which have been presented make possible some positive statement concerning the general intelligence of fifteen subjects, to each of whom, in addition to other tests, the Binet-Simon (Stanford Revision) tests were given. Some of the other in-

[6]Op. cit., Bd. 6, p. 34.
[7]Op. cit., p. 140.

vestigations have suffered from the lack of an adequate measure of intelligence. Of the fifteen subjects, three (S3, S5, and E6) may be characterized as having *very superior* general intelligence; five (C1, C5, S1, *S4*, and *E4*) as having *superior* general intelligence; four (C4, *S2*, S6 and *E2*) as having *average* general intelligence; two (E3 and E5) as having *slightly inferior* general intelligence; and one (E1) as having *markedly inferior* general intelligence. In addition to these to whom Binet tests have been given, three others may be classified with some assurance. The average results of 16 tests given to the Culver group seem sufficient to be taken as an indication of the mental ability of the cadets. If so, we may class *S7* and *S8* as having *average* general intelligence; perhaps with reference to an unselected group they would rank even higher. The general intelligence of *C3* appears to be *inferior* when estimated from the tests and his college performance. The tests of *C2* have not been extensive enough to make possible a sure estimate of his general intelligence. His school performance, however, would place him in the *superior* group.

We conclude, therefore, that (3) *A certain elementary ability in graphic representation, such as is required for success with elementary-school drawing, is independent, or partially independent, of general intelligence.*

How often we may expect the combination of good drawing ability of this elementary sort and poor mentality, our data do not give us the means of judging. Perhaps, owing to the selection of pupils in the upper grades on the basis of their success in studies requiring a fair degree of general intelligence, the number of these cases is larger than appears.

A complete diagnosis of talent in drawing, however, requires a measure of the general intelligence of the drawer. Although experimental studies of the abilities required in various pursuits which depend upon drawing ability are lacking, we may be fairly sure from other well-known facts that varying degrees of general intelligence are required for success in the different art callings. We should not expect successful copying of a design, for example, to require as great general intelligence as successful creation of a picture representing, let us say, the simple dignity of toil. Before one gets very far in art expression, a great number of supplementary factors must be brought to the support of the ability to represent graphically simple objects. Even the technique itself becomes progressively more difficult. More and more, conceptual factors—color harmony and color contrast, the values of light and shade, the devices for representation of linear perspective, the meaning of the lines of the face, the historical account of the effectiveness of various methods, the representation of ideas rather than simple objects, etc.—enter into the process, and ability to master these conceptual factors is a prerequisite of successful performance.

The study of our subjects has also given us some basis for inference concerning the relation of general intelligence to future development in drawing. We have already remarked (Chapter VI) that *C3,* who is inferior in general intelligence, seems unable to profit rapidly by the advanced instruction in technique offered in the art courses of the University. Likewise, we have the testimony of the art teacher that E1, whose general intelligence is markedly inferior, shows *less originality* than ability in graphic representation.

It is our conclusion, then, that (4) *General intelligence conditions the ability of drawers* (*a*) *to acquire the advanced technique into which conceptual factors enter, and* (*b*) *to create original drawings of merit.*

On the other hand, we can not deny the possession of an elementary ability in graphic expression by persons of low intelligence. The practical problem becomes one, then, of diagnosing a pupil's ability, prescribing for him the training which shall develop his talent in the most useful way, and directing him into the type of work with which he can have the greatest success. We have not fulfilled our duty to the drawer of low intelligence, when we have told him that he can never become a great painter, architect, or cartoonist. We must be prepared to develop his talent and to tell him of some place where he can use it to advantage. Perhaps, for example, he can become a sign painter or a copier of decorative patterns.

At the other extreme is the pupil of high general intelligence and talent for graphic representation. When we have diagnosed his ability, we shall have reason to expect that he will respond favorably to our treatment of him as a prospective creative artist. We shall not be content to place him in some position where he will be a mere copyist.

Linguistic Ability and Drawing

Binet mentions in his account of the psychology of Tade Styka[8] two types of intelligence; the sensory and the verbal. Persons belonging to the first type, he says, live in the exterior world and like to use their senses

[8]Binet, A. La psychologie artistique de Tade Styka. *L'Année Psychologique*, 15: 1908 (1909), 334f.

and their hands. They are painters, sculptors, and musicians. Persons belonging to the verbal type are distinguished by their talent for words and for abstract ideas of which the word is the key. Orators, journalists, mathematicians, and many scientists belong to this type. He states, however, that the types are not contradictory; a person may belong to both types.

Ivanof[9] found the correlation between drawing and language (reading, declamation, orthography, and grammar) contradictory and hence uncertain.

Ayer[10] found a strong positive correlation (r=.68) between achievement in drawing and English as shown by school grades in the case of 144 normal-school students. When, however, the drawings secured in a test of 51 high-school students were compared with the average of the class-standings of the same students in science, English, Latin, and mathematics, no correlation was shown. He concludes that "ability in representative drawing is not correlated with achievement in school subjects when it is isolated from the other factors of school drawing."

In our study we have found linguistic ability a better indicator of general intelligence than of either general motor ability or specific drawing ability. There may be some practical value in referring to motor (or sensory) and verbal types, but the classification of an individual in one of these types is not sufficient to indicate whether or not he can draw. As far as we may judge from our limited number of cases, we may conclude that (5) *Linguistic ability and talent in drawing are related only from the point of view that general intelligence and*

[9]Ivanof, E. Le dessin des écoliers de la suisse romande. *Archives de psychologie,* 8: 1908, 119.

[10]Op. cit., pp. 139ff.

talent in drawing are related; linguistic ability is no index of ability or lack of ability in graphic representation.

General Motor Ability and Drawing

The reference to Binet in the preceding section definitely connects a sensory type of intelligence with ability in drawing. Kik,[11] in a discussion of the relation of drawing ability to general intelligence, mentions a "mechanical copying as pure skill of hand" (*mechanische Kopieren als blosse Handfertigkeit*). The question still remains, of course, whether this skill of hand is uniformly connected with a general motor superiority.

The results of our tests reveal, in the first place, that general motor ability is a complex of varying factors. One who stands high in a given motor test may stand low in another. Moreover, we found our subjects making *uniformly* high (average or low) records neither in a single motor test nor in the average of the tests. One of our apparently most gifted subjects, S3, made low or average right-hand records in three of the motor tests. It is true that the "standard" records, with which the individual performances are compared, are based on a limited number of cases, but the variability in the records of our own subjects is sufficient to establish the general statement made above. The nearest approach to uniformity is in the strength of grip, but the uniformity is far from complete even in this test.

Our conclusion may be stated in the following terms: (6) *The motor ability which underlies talent for drawing is specific rather than general; talent for drawing does not presuppose a general motor superiority.*

[11] Op. cit., p. 148.

Handwriting and Drawing

In the general discussion of drawing at the beginning of this chapter, it was pointed out that the letters of the alphabet are drawings of a certain type. One would think, therefore, that ability in handwriting might be an index of a corresponding ability in drawing. The results of our tests, however, do not show that persons who draw well also write well. It may be, of course, that persons who are talented in drawing have a relatively greater *capacity for development* also in handwriting, but, if this is true, it is not evident from the achievement in handwriting which results from ordinary school training. There are, as a matter of fact, important differences between handwriting and drawing, regarded as processes. In handwriting, a limited number of symbols recur in substantially the same form time and again; in drawing, the objects to be represented or figures to be copied are much more numerous and varied. Furthermore, the differences in the writing and drawing movements bring them into sharp contrast. Freeman[12] emphasizes the difference between handwriting and drawing by giving one as an example of sensori-motor learning and the other as an example of perceptual learning:

"In learning to write, the child develops habits of movement and acquires the recognition of form, but since the motor coördination is the more prominent element, writing is taken as an illustration of sensori-motor learning. Drawing also includes both the recognition of form and its representation, but in this case the element of recognition is more prominent, and therefore drawing is taken as an illustration of perceptual learning."

We conclude, therefore, that (7) *Achievement in handwriting and ability in drawing are relatively independent of each other.*

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[12]Freeman, F. N. *The Psychology of the Common Branches,* 1916, p. 34.

Flexibility of Motor Habit and Drawing

It was thought that the ability to form the associations required in drawing might be inferred from a general flexibility of sensori-motor habit. This supposition was not confirmed, however, by the results of the mirror-drawing test. It is true that 11 of our 17 subjects who took this test are ranked as *superior* in relation to others of the groups with whom they are compared. A consideration of sex differences, however, will modify our judgment of this apparent superiority. Eight of the 11 who made superior records are girls and women, and the comparison in which the superiority appears is made with members of the opposite sex. But girls and women have generally been found superior to boys and men in the mirror-drawing test.[13] Miss Calfee found in a test of college freshmen that only 6 per cent of the men reached the women's median, while 90.4 per cent of the women reached the men's median.[14] If we compare the time taken by our high-school and adult subjects in the mirror-drawing test with the median time (66 seconds) reported by Miss Weidensall[15] for 36 college girls, we find that only two surpassed the median record. It is possible, therefore, that the superior records of some of our subjects are to be explained on the basis of sex differences rather than on the basis of differences which are directly related to ability in drawing. Moreover, a few of our records, as they stand, are average or poor.

It is not easy to interpret the results; perhaps we would best leave the discussion with the statement that

[13]Whipple's *Manual*, pp. 490ff.

[14]Calfee, Marguerite. College Freshmen and Four General Intelligence Tests. *Journal of Educational Psychology*, 4: 1913, 223-231.

[15]Weidensall, Jean. The Mentality of the Criminal Woman. *Educational Psychology Monographs*, No. 14, 1916, p. 223.

our results are insufficient for a conclusion. It is safe to say, however, that (8) *There is an elementary drawing ability which exists apart from a general flexibility of motor habit as far as this is revealed by the mirror-drawing test;* whether high standing in the mirror-drawing test indicates a constitution favorable to development in drawing, we do not know.

Sensory Discrimination and Drawing

Free-hand drawing requires frequent judgment of distances, lengths, curves, and magnitudes. The question arises, then, whether persons who are talented in drawing have also a superior power of sensory discrimination. We applied our tests of discrimination of differences and proportions (Number 37 and 38) to 9 of the subjects of this study, and the first of these tests to 6 others. While our background of comparative results is quite meager, we have no reason to suppose that our subjects have the ability to make finer discriminations of magnitudes than have persons of similar training but less talent in drawing. Notwithstanding this statement, however, tests of sensory discrimination would seem to have a diagnostic value. It is important for pedagogical purposes to know whether a pupil judges lengths, angles, and curves well or poorly, as it is important for vocational purposes to know whether a given drawer may be expected to be 'true' to the proportions of his copy.

We may conclude, then, that (9) *The ability to discriminate fine differences in visual magnitudes varies in persons talented in drawing; the measurement of this ability is of value in a determination of the factors of drawing ability regarded as a complex.*

Observation and Drawing

Obviously, one must see before one can draw. Indeed, what one sees is, or at least includes, what one draws. The references to Meumann and Ayer in the earlier part of this chapter emphasized the part played by analytical observation in the ability to draw. Judd and Cowling[16] made a study of the perceptual process in drawing and found characteristic differences in the way in which the perception of a simple form is built up. At the extremes are those individuals who proceed from details to the whole form, and those who get the general outline in mind first. Kerschensteiner[17] states that the development of graphical expression is most intimately connected with the apprehension of the *total form* of objects. The effect of practice upon visual apprehension was studied by Whipple,[18] Foster,[19] and Dallenbach.[20] The first two, working with adult subjects, found some improvement with practice, but explained it on the basis of adaptation and the development of assimilative devices, rather than on the basis of an improvement in the power of visual apprehension *per se*. Dallenbach working with school children, found an initial rapid improvement and a later slower improvement with practice. He found also a direct but small

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[16]Judd, C. H., and Cowling, D. J. Studies in Perceptual Development. *Psychological Review Monographs*, 8, 1907, 349-369.

[17]Kerschensteiner, G. *Die Entwicklung der zeichnerischen Begabung*, 1905, p. 486.

[18]Whipple, G. M. The Effect of Practice upon the Range of Visual Attention and of Visual Apprehension. *Journal of Educational Psychology*, 1: 1910, 250-262.

[19]Foster, W. S. The Effect of Practice upon Visualizing and upon the Reproduction of Visual Impressions. *Journal of Educational Psychology*, 2: 1911, 11-22.

[20]Dallenbach, K. M. The Effect of Practise upon Visual Apprehension in School Children. *Journal of Educational Psychology*, 5: 1914, 321-334, 387-404.

correlation of visual apprehension with age. Each of the three studies revealed marked individual differences.

In our study we used four tests (Numbers 32, 33, 34, and 35) which seem to have some direct relation to observation. The cancellation test, the Rossolimo test, and the stamp test demand analytical observation. The spot-pattern test demands a knowledge of details, but also gives ample play to the power of seeing a form as a whole. The stamp test proved to be of doubtful value, because of the introduction of the linguistic factor into the test in the writing of the description. The cancellation test involves other factors[21] which may quite obscure the ability to observe analytically. The Rossolimo test is rather too brief for reliable results. And for the spot-pattern test we have lacked comparable data. Our results for the spot-pattern test, however, are sufficient to indicate wide individual differences even among persons talented in drawing. In the cancellation test, nearly all of our subjects made superior or average records. In the Rossolimo test, only one of our subjects in the high-school and adult group, for comparison with the members of which we have a few comparable records, made a poor score.

Our conclusion must, therefore, be tentative: (10) *While persons who are talented in drawing exhibit considerable individual differences in tests of observation, these tests appear to have some diagnostic value for talent in drawing;* their relation, however, to ability in drawing is not clearly made out in our study.

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[21]Cf. Whipple's *Manual*, p. 305: "The test is rather remarkable for the variety of forms it has assumed, the variety of names that have been given it, and the divergence of statement as to what it really measures."

Imagery and Drawing

The part played by the image in the drawing act has been discussed by different investigators. The references to Albien, Meumann, and Ayer in the beginning of this chapter may be taken as examples of this discussion. The importance of clear visual imagery is especially emphasized. Ayer writes, for example:[22]

"The clearness of visual imagery, particularly in memory drawing, is of great importance to accurate representation and is subject to great individual variation. With different individuals the drawing image may be (1) clear and distinct, (2) vague and incomplete, (3) distinct, but inaccurate, or (4) changeable and evanescent when the act of drawing begins."

On the other hand, Foster found in the study mentioned in the preceding section that:[23]

"In no case did practice increase the ability or even the tendency to visualize. The best reproducer of visual impressions was the poorest visualizer, and relied almost wholly upon verbal cues for recall."

Binet's tests of Tade Styka, the young painter, did not reveal an exceptional visual memory. Binet writes:

"I shall add also the conclusion that one may be an admirable draughtsman with a very ordinary visual memory."[24]

In our investigation with the use of the Betts questionary, six of nine subjects reported visual imagery of superior clearness in comparison with the Betts results; one reported visual imagery of average clearness; and two reported visual imagery markedly below the average in clearness. Auditory imagery, with two minor exceptions, was reported as of about the same clearness as the visual. Only one subject reported *superior* kinaesthetic imagery.

In reporting these results, attention should be invited to the fact that our subjects were untrained in introspection. We are frankly skeptical of the ability of un-

[22]Op. cit., p. 159.
[23]Loc. cit., p. 11.
[24]Op. cit., p. 330.

trained observers to give reliable accounts of their imaginal processes.[25] We may at least offer the conclusion that (11) *Our 'introspective' records do not support the view that superior clearness of visual (or kinaesthetic) imagery is essential to talent in drawing.* Logically, perhaps, clear visual imagery is a great asset to the drawer; but the matter is one for decision by scientific inquiry rather than by logic. The relation of imaginal processes to drawing is still a subject for investigation by the introspective psychologist.

Drawing and Memory for Visual Forms

In a test of memory for visual forms we may be somewhat more certain of our results with untrained observers—and we are interested in tests for children—than we can be in an introspective inquiry concerning imaginal processes. Our results with tests of the memory for visual forms show wide individual differences. We conclude, however, that (12) *Tests of the memory for visual forms have value in determining the characteristics of one's drawing ability; but one may have a certain ability in graphic representation without a good memory for visual forms, other than the immediate memory required in looking from the object to the drawing surface.* The type of test which appears to be of particular value is that requiring a test of the memory by graphic reproduction—represented by our Test Number 27.

Drawing and Mental Manipulation of Spatial Forms

In our tests of the power mentally to manipulate spatial forms, (Numbers 13, 14, 15, and 16) we found

[25] Compare the writings of introspective psychologists. For example, see Titchener, E. B. *A Beginner's Psychology*, 1915, p. 20ff.

great individual differences among our subjects and also in some cases marked differences in performances of the same person. The significance of these differences is not clearly made out. Probably performance in the more difficult of the tests is rather directly related to general intelligence, in that they require the holding of an object in attention and uninterrupted application for a considerable time. The factor of familiarity with the material, as, for example, the familiarity with geometrical names and objects, appears also to be important. At all events, it is important for instructional purposes to determine whether a pupil has the power of concentrated attention to a difficult task in the type of material with which he must deal.

Our conclusion is that (13) *Persons talented in drawing show wide individual differences in their power mentally to manipulate spatial forms; tests of this ability are of value to determine in detail the nature of the drawing talent.*

Drawing and Invention from Graphic Forms

Inventiveness is obviously a great element of achievement in art. It would be desirable, if it were possible, to measure the inventiveness of pupils by means of tests. We used two tests of invention from graphic forms, the ink-blots tests and the pictorial imagination test. Our experience with them, however, indicates that as conducted in this experiment they are of doubtful value. We are compelled to state merely a negative conclusion: (14) *No clear relation is apparent between ability in drawing and the invention from graphic forms which was required in our tests.*

Drawing and Aesthetic Judgment

Great achievement in art demands a good judgment of aesthetic values. Meumann, in the reference cited early in this chapter, has called attention to the need of an artistic sense for ability in drawing. He thinks, however, that this artistic sense is a product of training rather than a matter of endowment. Prosser,[26] a practical worker in the field of art education, recognizes the problem of training in art appreciation as a vital one. He believes that, if we would have persons to appreciate aesthetic excellence in any particular line—pictures, statuary, clothing, house furnishings, and so on—we must train them *specifically* for this appreciation.

In our tests (Numbers 17 and 18) we found a wide variability between the results of the two tests and among the performances of different individuals with the same test. The Thorndike test apparently is designed to measure the aesthetic appreciation of abstract graphic forms. We are not convinced, however, that it is a reliable measure of this appreciation. The Illinois test requires judgments between drawings, pictures, and designs. Many of the principles upon which the excellence of these figures is to be judged may be conceptualized and stated. Consider, for example, the principles of proportion, similarity of treatment, and color combination. We are, therefore, at a loss to know how much the performances in this test were based upon a native aesthetic ability and how much they were the result of training. It is quite clear, however, that (15) *Quality of performance in graphic representation and quality of*

[26]Prosser, C. A., Director of Dunwoody Institute, Minneapolis, Minnesota. Art Training for Industry. *Bulletin of the Western Drawing and Manual Training Association,* Vol. 1: No. 2 (Annual Report for 1916), pp. 30f.

performance in aesthetic judgment are independent, or at least partially independent variables. Training in graphical representation is not sufficient to assure good aesthetic taste.

Interest and Talent in Drawing

Sargent and Miller have called attention to the fact that apparent talent may consist in a special interest rather than in an endowment of skill:[27]

> ...."As a matter of fact, the representation of isolated things does not furnish an adequate motive for children except for the few to whom form and color of themselves make an unusually strong appeal and awaken a vivid inner experience. For these few, desirous to express what so strongly impresses them, ordinary nature and object drawing is sufficient, and they make excellent progress in it. These are the children with so-called 'special talent.' In most cases this type of talent in elementary schools appears to consist primarily in a special interest and not in a special endowment of skill. This interest is related to skill as cause to effect. In other words, if we can induce an equal interest on the part of other children, they will develop equal skill. One of the significant facts brought out in the course of the work previously described is that not infrequently children who show under ordinary circumstances no indications of talent will, when the appeal to their particular interests is found, equal or surpass in skill those who appeared at first to be gifted artistically."

We have no reason to doubt that this quotation expresses a very important truth. On the other hand, it is just as true that we tend to be interested in the things which we are able to do well. One of our subjects (*S2*), it will be recalled, reports that he lost interest in drawing when it appeared that he did not succeed in water-color drawing as well as others in the schools, and that even today he dislikes that type of drawing. The same subject reports a revival of interest in drawing when he discovered that he could draw better than the pupils in the schools which he then attended. That interest and achievement in drawing are positively correlated is clear enough. The number of our subjects who report an in-

[27] Sargent, Walter, and Miller, Elizabeth. *How Children Learn to Draw*, 1916, p. 235.

terest in drawing very early in life emphasizes the closeness of this correlation. We conclude, therefore, that (16) *Interest may indicate either a superior innate ability or merely a high development of a rather ordinary endowment, but it is of immense practical importance as an index of the energy which one is willing to expend in the development of one's ability and in practical achievement.*

Summary

We have seen that there is great variability in the mental and physical characteristics of persons who are talented in drawing. The nature of some of these differences has been reviewed, and a number of conclusions have been expressed concerning particular characteristics in their relation to drawing. It is now clear that (17) *There is no one psychophysical constitution for talent in drawing; the essential characteristics vary with the type of talent possessed.* Every normal individual should be thought of as possessing in some degree all of the elemental abilities which make drawing possible. When the strength of an element or combination of elements varies above the "average" or when the elements enter into a particularly favorable combination or appropriate pattern, we have a *talent* as defined in this study, an ability which tends toward superior achievement.

The fact that the essential characteristics vary does not prevent our listing some of the factors which seem closely related to ability in drawing. No attempt is made to make the list complete; indeed the list of all the abilities which have any bearing upon achievement in drawing would be extremely long.

It will be observed, also, that the items in the list are neither mutually exclusive nor elemental in the sense that they cannot be further analyzed. It is believed necessary only that the separate items have a rather close relation to ability in drawing, that they be capable of description and recognition apart from the complex in which they are observed, and that so far as possible they be measurable. (18) *The following characteristics, each an independent or partially independent variable, seem closely related to ability in drawing:*

(1) *The ability mentally to note a visual form, and, by certain lines and areas, to reproduce it or significant features of it.*
(2) *Ability to observe.*
(3) *Ability to select from a complex visual situation the most representative and the most beautiful aspects.*
(4) *Memory for visual forms.*
(5) *Ability mentally to manipulate visual forms.*
(6) *Ability to control hand movements in accordance with visual percept or image.*
(7) *Ability to invent, to bring together into new artistic combinations the elements of different visual experiences.*
(8) *Ability to judge the beautiful in line, form, color, and composition.*
(9) *Ability to discriminate differences in color.*
(10) *Ability to discriminate differences in visual magnitude.*
(11) *Acuity of vision.*
(12) *Interest in the act and products of drawing.*
(13) *General intelligence.*

Chapter VIII

THE TEST METHOD AND THE DIAGNOSIS OF TALENT IN DRAWING

Introduction

The second question which was raised in the statement of the problem of this research was this: *How may the test method be used in the diagnosis of talent in drawing?* The discussion of the preceding chapter bears incidentally upon this topic, and at different places earlier in the text pertinent suggestions have appeared. It is the purpose of the present chapter, however, to consider the question more specifically.

The test method needs no defense; its scientific validity is well established.[1] And we have seen in Chapter I that the primary purpose of the test is diagnosis. We may proceed immediately, therefore, to a consideration of tests in their relation to the particular problem of talent in drawing.

Types of Tests for Diagnosis of Drawing Talent

The discussion of the preceding chapter has prepared the way for certain conclusions concerning the types of tests which will be valuable in the diagnosis of talent in drawing.

At first thought the problem seems simple enough: if one would test the ability of persons in drawing, merely have them draw something and then estimate the value of the product. But the solution is not so easy.

[1]See the discussions of Stern and Whipple: Stern, W. *Die differentielle Psychologie*, pp. 87ff; Whipple's *Manual*, pp. 1ff.

This study has emphasized the fact that drawing is a complex activity, that ability in drawing is analyzable into many factors each of which is a variable, and that there is no one psychophysical constitution for talent in drawing. One may have talent in a particular type or phase of drawing and have little ability in another. Moreover, apparently the same objective result may be produced by abilities which differ widely in the strength of their constituent factors. Both efficient instruction and helpful vocational guidance demand a knowledge of these factors severally. We conclude, then, that (1) *A diagnosis of talent in drawing must be based upon an analysis of the talent and a measurement of the constituent psychophysical factors.*

(2) *The following program of tests is recommended for the diagnosis of talent in drawing:*[2] (See close of Chapter VIII).

(1) *Tests of the elementary ability to represent, by lines and areas, figures and objects observed.*

(2) *Tests of the ability to observe.*

(3) *Tests of the ability to select from a complex visual situation the most representative and the most beautiful aspects.*

(4) *Tests of the memory for visual forms.*

(5) *Tests of the ability mentally to manipulate visual forms.*

(6) *Tests of the ability to control hand movements in accordance with visual percept and image.*

(7) *Tests of the ability to invent, to bring together into new artistic combinations the elements of different visual experiences.*

[2]The order of tests in this list is not significant.

(8) *Tests of the ability to judge the beautiful in line, form, color, and composition.*

(9) *Tests of the ability to discriminate differences in color.*[3]

(*10*) *Tests of the ability to discriminate differences in visual magnitude.*

(*11*) *Tests of acuity of vision.*

(*12*) *Tests of general intelligence.*

Other Considerations

(3) *Interpretation of the results of the tests necessitates standards of achievement with which the performance of a given individual may fairly be compared.* A particular score in a test means little until it is compared with the scores made by others.

When studying special ability, investigators must be particularly careful in the conclusions which are drawn from the gross results of the tests employed. Accidents of opportunity and of interest may occasion a very uneven development of different abilities in the same individual and of the same abilities in different individuals. It seems probable, therefore, that it will be much more difficult to estimate real native endowment in a study of special ability than in a study of general intelligence, for in the latter we expect lack of development of one factor to be compensated in a measure by greater development of another. It must not be forgotten, of course, that what we are really testing at a given time is the *native endowment as this has been modified* by all the individual's previous experience. In this connec-

[3]It is interesting to note in this connection that the painter Tade Styka was, if we may accept his father's testimony, "color-blind" until eight years of age! (See Binet, A. La psychologie artistique de Tade Styke. *L'Année psychologique*, 15: 1908 (1909), 320.

tion the facts set forth in the following three paragraphs should be emphasized.

(4) *Every child should be given a many-sided opportunity in drawing and an attempt should be made to develop corresponding interest.* Our immediate concern in this proposition is based upon the relation of opportunity to the development of native ability and its diagnosis by appropriate tests. Equal opportunities for development will tend to accentuate the original individual differences, so that the gifted child will tend even more to exhibit that talent when the tests for diagnosis are given. If the opportunities are very uneven, the child of mediocre ability but of exceptional opportunity may appear to be the really gifted one. In addition to the foregoing we may mention, as reasons for giving every child an opportunity in drawing, the value of an early beginning in any complicated learning, the significance of having every member of the community trained to some extent in the appreciation of art, and the social importance of developing a talent which might without early direction lie dormant because overshadowed by some other but less well endowed interest.

(5) *Biographical and personal data of a non-experimental character should be used to assist in the diagnosis of talent in drawing.* Due consideration should be given, for example, to the opportunity for drawing which the child has had, to the presence or absence of other interests which might influence the development of drawing ability, to his heredity, and to the home influences under which he has been reared.

(6) *It is recommended that tests which are used for the purpose of estimating the possibilities of improvement in any given factor be conducted as 'instructed-*

learning' tests, as explained herewith. It is one thing to test an ability for the purpose of finding its present strength, and quite another to test it for the purpose of estimating how much it is capable of improvement.

The 'instructed-learning' test consists of different sections of test material interspersed with definite instructions concerning method. If the test were one of drawing, for example, the subject might be asked to make a series of drawings on successive days, and before each drawing (except perhaps the first) be given very definite instructions designed to teach him the best method to employ in the drawing. Each successive time the instructions could be made to include additional points of technique. It is hardly to be expected that children will of themselves adopt the best method or even the same method for doing the task assigned. It will reduce the number of variables in the test, if the experimenter can himself determine the method to be employed by the subject. In a test of this type, we shall have a device for the detection of undeveloped talent, and, in the learning curve, a basis for the estimation of the possibilities of development.

It will be observed that the tests which we have recommended do not include any which require the subject to 'introspect' in the technical sense of the term. It is believed that, when subjects who are untrained in introspection, as will be the case with most of those who are tested for ability in drawing, are asked to observe and report their mental processes, only unreliable results may be expected. Moreover, we are not at all convinced that the relation of particular imaginal processes to success in drawing has been satisfactorily established by investigators whose writings we have reviewed.

Undoubtedly, a program for the diagnosis of talent in drawing has important implications for the diagnosis of other kinds of talent. These cannot be discussed here except to point out that (7) *The measurement of many different abilities not primarily related to drawing is necessary to the most effective educational and vocational use of measurements of ability in drawing.* Consider, for example, the different treatment demanded by the following types of cases: (a) a person who has considerable talent in drawing but greater talent in music, and (b) one who has relatively little talent in drawing but more in drawing than can be discovered in any other activity of equal social value.

The Needs

Some of the specific needs which have been suggested in the course of this research are the following:

1. The development of equivalent tests. (See the first part of Chapter IV.)
2. Statistical studies of the frequency of specialized ability. For purposes of school administration, it would be of service to know what percent of the pupils enrolled have specialized abilities of great vocational or social importance.
3. The development of better tests and standards of achievement for measuring the gross products of drawing.
4. The development of tests and standards for measuring:
   (1) The elementary ability to represent, by lines and areas, figures and objects observed.
   (2) The ability to observe, with special reference to drawing.

(3) The ability to select from a complex visual situation the most representative and the most beautiful aspects.

(4) The ability to remember visual forms.

(5) The ability mentally to manipulate visual forms, with special reference to the manipulation required in drawing.

(6) The ability to control hand movements in accordance with visual percept and image.

(7) The inventive ability in drawing.

(8) The aesthetic judgment. It would be an uncommonly great service to devise some test which would measure, not one's knowledge of aesthetic principles or one's ability to make correct aesthetic judgments, but the extent to which one is really *moved* by a beautiful object.

5. Studies of successful persons in various art vocations in order to determine the type of ability which the several vocations require.

6. Introspective studies of the relation of the imaginal processes to ability in drawing.

Chapter IX

SUMMARY OF CONCLUSIONS

Purpose of Chapter

It is the purpose of the present chapter to bring together the main conclusions which we have been able to draw in this study. These conclusions have been stated in Italics in Chapters VII and VIII, and the same numbering which was used in those chapters has been retained in the following list.

The Psychophysical Characteristics of Persons Talented in Drawing

(Chapter VII)

1. The production of an effective drawing includes many theoretically distinguishable activities.

2. Persons talented in drawing exhibit great individual differences in their psychophysical characteristics.

3. A certain elementary ability in graphic representation, such as is required for success with elementary-school drawing, is independent, or partially independent, of general intelligence.

4. General intelligence conditions the ability of drawers (*a*) to acquire the advanced technique into which conceptual factors enter, and (*b*) to create original drawings of merit.

5. Linguistic ability and talent in drawing are related only from the point of view that general intelligence and talent in drawing are related; linguistic ability

is no index of ability or lack of ability in graphic representation.

6. The motor ability which underlies talent for drawing is specific rather than general; talent for drawing does not presuppose a general motor superiority.

7. Achievement in handwriting and ability in drawing are relatively independent of each other.

8. There is an elementary drawing ability which exists apart from a general flexibility of motor habit as far as this is revealed by the mirror-drawing test.

9. The ability to discriminate fine differences in visual magnitudes varies in persons talented in drawing; the measurement of this ability is of value in a determination of the factors of drawing ability regarded as a complex.

10. While persons who are talented in drawing exhibit considerable individual differences in tests of observation, these tests appear to have some diagnostic value for talent in drawing.

11. Our 'introspective' records do not support the view that superior clearness of visual (or kinaesthetic) imagery is essential to talent in drawing.

12. Tests of the memory for visual forms have value in determining the characteristics of one's drawing ability; but one may have a certain ability in graphic representation without a good memory for visual forms, other than the immediate memory required in looking from the object to the drawing surface.

13. Persons talented in drawing show wide individual differences in their power mentally to manipulate spatial forms; tests of this ability are of value to determine in detail the nature of the talent.

14. No clear relation is apparent between ability in drawing and the invention from graphic forms which was required in our tests.

15. Quality of performance in graphic representation and quality of performance in aesthetic judgment are independent, or at least partially independent variables.

16. Interest may indicate either a superior innate ability or merely a high development of a rather ordinary endowment, but it is of immense practical importance as an index of the energy which one is willing to expend in the development of one's ability and in practical achievement.

17. There is no one psychophysical constitution for talent in drawing; the essential characteristics vary with the type of talent possessed.

18. The following characteristics, each an independent or partially independent variable, seem closely related to ability in drawing:

(1) The ability mentally to note a visual form, and, by certain lines and areas, to reproduce it or significant features of it.

(2) Ability to observe.

(3) Ability to select from a complex visual situation the most representative and the most beautiful aspects.

(4) Memory of visual forms.

(5) Ability mentally to manipulate visual forms.

(6) Ability to control hand movements in accordance with visual percept or image.

(7) Ability to invent, to bring together into new artistic combinations the elements of different visual experiences.

(8) Ability to judge the beautiful in line, form, color, and composition.

(9) Ability to discriminate differences in color.

(10) Ability to discriminate differences in visual magnitude.

(11) Acuity of vision.

(12) Interest in the act and products of drawing.

(13) General intelligence.

The Test Method and Diagnosis of Drawing Talent

(Chapter VIII)

1. A diagnosis of talent in drawing must be based upon an analysis of the talent and a measurement of the constituent psychophysical factors.

2. The following program of tests is recommended for the diagnosis of talent in drawing:

(1) Tests of the elementary ability to represent, by lines and areas, figures and objects observed.

(2) Tests of the ability to observe.

(3) Tests of the ability to select from a complex visual situation the most representative and the most beautiful aspects.

(4) Tests of the memory for visual forms.

(5) Tests of the ability mentally to manipulate visual forms.

(6) Tests of the ability to control hand movements in accordance with visual percept and image.

(7) Tests of the ability to invent, to bring together into new artistic combinations the elements of different visual experiences.

(8) Tests of the ability to judge the beautiful in line, form, color, and composition.

(9) Tests of the ability to discriminate differences in color.

(10) Tests of the ability to discriminate differences in visual magnitude.

(11) Tests of acuity of vision.

(12) Tests of general intelligence.

3. Interpretation of the results of the tests necessitates standards of achievement with which the performance of a given individual may fairly be compared.

4. Every child should be given a many-sided opportunity in drawing and an attempt should be made to develop corresponding interest.

5. Biographical and personal data of a non-experimental character should be used to assist in the diagnosis of talent in drawing.

6. It is recommended that tests which are used for the purpose of estimating the possibilities of improvement in any given factor be conducted as 'instructed-learning' tests.

7. The measurement of many different abilities not primarily related to drawing is necessary to the most effective educational and vocational use of measurements of ability in drawing.

Conclusion

This study has resulted in a somewhat detailed statement of the nature of talent in drawing and has yielded

a tentative program of tests for the measurement of this talent. In addition specific needs for further study have been indicated. It is a bit disconcerting, however, to leave the investigation where this unit of work must leave it. Now that we know something of the characteristics of those who draw and have devised a program for measuring these characteristics, it seems unfortunate that we are unable at the same time to publish the material and standards for the tests recommended.[4] But of this list of tests, only two (tests of acuity of vision and tests of general intelligence) may be regarded as fairly satisfactory in their present form for the purpose in hand, and these are easily available elsewhere. It is clear, however, that appreciable progress is being made in this new field, the use of tests in the diagnosis of special ability, and we may look to the future with confidence.

BIBLIOGRAPHY

The following is a list of the authors and titles to which reference has been made in this study:

Albien, G. Der Anteil der nachkonstruierenden Tätigkeit des Auges und der Apperception an dem Behalten und der Wiedergabe einfacher Formen. *Zeitschrift für Experimentelle Pädagogik,* Bd. 5: 1907, 133ff; Bd. 6: 1908, 1ff.

Albien's experiment represents an elaborate attempt to isolate experimentally the various parts of the drawing process. Simple figures of varying difficulty were used for copy. Three methods of exposure were used. The first was an exposure for ten seconds by means of the tachistoscope, during which period the eyes remained fixed upon the same point. In the second method, the subject was permitted to view the copy until he thought that he could reproduce it; then he attempted to draw it from memory. In the third method,

[4]Owing to the fact that the writer was almost two years in the military service, he has found it impossible up to the date of this publication to prepare any of the tests for general use. It is hoped that the near future will furnish opportunity for carrying forward this task. The concluding remarks above are based on the status of the tests in 1917.

the figure was drawn with the copy in view. The subjects in the experiments were forty-five pupils, ages 9 to 18, from the *Realschule*. These included children of good, average, and poor ability in drawing and of good and poor intelligence. All except nine pupils had received instruction in free-hand drawing.

Ayer, F. C. The Psychology of Drawing with Special Reference to Laboratory Teaching. Baltimore, Warwick and York, 1916. Pp. 186.

Contains comprehensive summary of the literature of drawing. Reports also an experimental study of drawing with special reference to laboratory procedure. (1) Four groups of subjects were tested with unfamiliar objects as to their abilities in drawing, description, and diagramming. Correlations were made between the orders of merit of these productions. The groups were (a) 51 high school students, (b) 48 graduate students, (c) 50 college students, and (d) 61 college students. Three of the groups were examined as to their memory of details after they had drawn and described various objects. The second group made introspective analysis of the processes involved, after drawing and describing an object. (2) Grades of 51 high school students were compared with their ranking in drawing as discovered in the special tests. (3) Grades in drawing received by 141 normal school students were compared with the grades received in all other subjects. (4) 16 students were given an experimental test in the effect of analytical seeing upon drawing.

Betts, George H. The Distribution and Functions of Mental Imagery. (Doctor's dissertation, Columbia University, 1909.)

Contains the questionary which was used for the study of imagery in this study.

Binet, A. La psychologie artistique de Tade Styka. *L' Année psychologique,* 15: 1908 (1909), 315-356.

Report of a study of a young painter, Tade Styka. See Chapter II of this volume.

Bonser, F. G. The Reasoning Ability of Children of the Fourth, Fifth, and Sixth Grades. New York, Teachers College, 1910. Pp. 133.

Reports an attempt to measure by means of tests the reasoning abilities of children. Factors measured were mathematical judgment, controlled association, selective judgment, and literary interpretation.

Calfee, Marguerite. College Freshmen and Four General Intelligence Tests. *Journal of Educational Psychology,* 4: 1913, 223-231.

Four general intelligence tests (card sorting, card dealing, alphabet sorting, and mirror drawing) were applied to 103 college freshmen. Correlations were made between the results of the different tests and between the results of each test and the scholastic standing of the students.

Claparède, Ed. Profils psychologiques gradués d'après l'ordination des sujets avec quelques mots sur l'utilité des profils en psychologie légale. *Archives de psychologie,* 16: 1916, No. 61, 70-81.

Contains illustrations of methods of graphing the performances of an individual in different tests so that both the score and the relative standing are indicated.

Cubberley, E. P. Editor's Introduction to Freeman's *Experimental Education.*

Introductory discussion of experimental education.

Dallenbach, K. M. The Effect of Practise upon Visual Apprehension in School Children. *Journal of Educational Psychology,* 5: 1914, 321-334, 387-404.

Supplements the work of Whipple and Foster (see respective titles). The subjects were school children.

Foster, W. S. The Effect of Practice upon Visualizing and upon the Reproduction of Visual Impressions. *Journal of Educational Psychology,* 2: 1911, 11-22.

The material of the experiment consisted of real objects, pictures, and nonsense drawings. The time of exposure was from 10 to 60 seconds. The drawing was sometimes accompanied by written description. The subjects were three adults.

Freeman, F. N. Experimental Education. Boston, Houghton Mifflin, 1916. Pp. 220.

A laboratory manual of experiments and typical results in experimental education. Contains introduction by E. P. Cubberley, to which reference is made in this study.

Freeman, F. N. The Psychology of the Common Branches. Houghton Mifflin, 1916. Pp. 275.

A text-book in educational psychology as applied to the common branches. Contains a chapter on drawing.

Healey, W. H., and Fernald, Grace M. Tests for Practical Mental Classification. *Psychological Review Monographs,* 13: 1911, No. 2.

Describes a number of tests used by the authors in the Chicago Juvenile Psychopathic Institute.

Ivanof, E. Le dessin des écoliers de la suisse romande. *Archives de psychologie,* 1908, VIII: 97ff.

The author examined critically 9764 drawings collected from 2441 pupils in the Swiss schools in an investigation planned by Claparède and Guex. Each child drew (1) from a copy a chair or stool, (2) from memory a cat, (3) to illustrate the fable of *Le Corbeau et du Renard,* and (4) from free choice any object. The drawings were accompanied by information as to the age, sex, nationality, rank in general work, subjects for which the most and least aptitudes were shown, etc. The drawings were evaluated according to three standards: correctness of proportions of the drawings, imaginative conception of the drawer, and the technical and artistic value of the drawing. Various correlations between aptitude in drawing and other aptitudes were made. The correlations were made according to age rather than school grade.

Judd, C. H., and Cowling, D. J. Studies in Perceptual Development. *Psychological Review Monographs,* 8: 1907, 349-369.

An experimental study of the way in which the perception of simple visual forms is developed. A simple figure composed of straight and curved lines was exposed for ten seconds and the subjects immediately afterward attempted to reproduce it. The figure was exposed repeatedly until the subject was able to reproduce its essential form.

Kerschensteiner, Georg. *Die Entwicklung der zeichnerischen Begabung.* Munich, Gruber, 1905. S. 508.

A comprehensive study of children's drawings. Many *facsimile* reproductions are given of drawings illustrating stages of development. See Chapter II of this study.

Kik, C. Die übernormale Zeichnenbegabung bei Kindern. *Zeitschrift für angewandte Psychologie,* 2: 1908, 92-149.

A study of 13 children talented in drawing. See Chapter II of this volume.

Meumann, E. Vorlesungen zur Einführung in die experimentelle Pädagogik, 2d ed, Bd. 3. Englemann, Leipsig, 1914.

Brings together a vast amount of material in the field of experimental education. Contains an elaborate analysis of drawing.

Prosser, C. A. Art Training for Industry. *Bulletin of the Western Drawing and Manual Training Association,* Annual Report for 1916, 1 : No. 2, 22-31.

An interesting discussion of problems in art training from the point of view of a practical worker in art education.

Pyle, W. H. A Manual for the Mental and Physical Examination of School Children. *The University of Missouri Bulletin,* Vol. 17: 1916, No. 24.

Describes a number of tests and gives norms of comparative results.

Robinson, J. B. Architectural Composition, New York, Van Nostrand, 1908; Second Edition (?). Pp. 234.

A formulation of principles of architecture. Illustrated.

Rossolimo, G. Die psychologische Profile. Zur Methodik der quantitativen Untersuchung der psychischen Vorgänge in normalen und pathologischen Fällen. *Klinik für psychische und nervöse Krankheiten,* Bd. 6: 1911, Heft 3. See also the same title in Heft 4 and the following article:

Rossolimo, G. Berichtigungen under Ergänzungen zur Methodik der Untersuchung der Psychologischen Profile. *Klinik für psychische und nervöse Krankheiten,* Bd. 8: 1914, Heft. 2.

In these references the author describes a method of testing a number of mental processes. Ten tasks are given in each test. The psychological profile is a graph which represents the number of tasks correctly done in each test, or the mean number done in each group of related tests.

Rugg, H. O. The Experimental Determination of Mental Discipline in School Studies (Descriptive Geometry and Mental Discipline). Thesis, University of Illinois. Baltimore, Warwick and York, 1916. Pp. 132.

Summarizes the experimental literature of mental discipline, and reports an experimental study conducted by the author. Of interest in the study of drawing because of the use made of tests requiring mental manipulation of visual forms.

Sargent, W., and Miller, Elizabeth. How Children Learn to Draw. Boston, Ginn, 1916. Pp. 264.

An account in detail of methods of teaching children to draw.

Stern, W. Die differentielle Psychologie in ihren methodischen Grundlagen. Leipzig, Barth, 1911. Pp. 503.

A valuable discussion of differential psychology as a new scientific discipline. Methods of acquiring materials, investigating individual differences, and studying individualities are discussed at length. The bibliography contains upwards of 1500 titles.

Stern, W. The Supernormal Child. *Journal of Educational Psychology,* 2 : 1911, 143-148, 181-190.

Discusses the child of superior ability. Author urges that something be done for the gifted child, and discusses the practical and theoretical problems of the treatment of superior endowment.

Terman, L. M. The Measurement of Intelligence. Boston, Houghton Mifflin, 1916. Pp. 362.

"An explanation of and a complete guide for the use of the Stanford revision and extension of the Binet-Simon intelligence scale." Contains bibliography.

Thorndike, E. L. Tests of Esthetic Appreciation. *Journal of Educational Psychology,* 7 : 1916, 509-522.

Describes tests for appreciation of graphic forms and of poetry.

Titchener, E. B. A Beginner's Psychology. Macmillan, New York, 1915. Pp. 362.

A text-book in elementary psychology.

Trabue, M. R. Completion Tests for Public School Use. *Fifteenth Yearbook of the National Society for the Study of Education,* 1916, pp. 52-59.

Discusses the Trabue language tests particularly from the point of view of their use in public schools.

Trabue, M. R. Completion Test Language Scales. Doctor's Dissertation, Columbia University, 1916.

Describes the derivation, methods of scoring, etc., of the Trabue language scales. Contains copies of the scales.

Weidensall, Jean. The Mentality of the Criminal Woman. *Educational Psychology Monographs.* No. 14, 1916.

A study of criminal women in the Bedford Hills, New York, Reformatory. Contains comparative data from tests of college girls and maids.

Whipple, G. M. The Effect of Practice upon the Range of Visual Attention and of Visual Apprehension. *Journal of Educational Psychology,* 1 : 1910, 250-262.

In experimenting upon the range of attention, tachistoscopic exposure was made of 5, 6, and 7-place series of isolated letters. In experiments with the range of apprehension, dots, pictures, drawings, nonsense syllables, poetry, and objects were used. The subjects were adults.

Whipple, G. M. Manual of Mental and Physical Tests. Baltimore, Warwick and York, 1910; Second Edition, Vol. 1, 1914, Vol. 2, 1915. Pp. 365 and 336.

An encyclopedia of information on mental and physical tests. Contains descriptions of many tests and extensive bibliographies. Volume 1 includes a discussion of the statistical treatment of numerical results.

Woodworth, R. S., and Wells, F. L. Association Tests. *Psychological Review Monographs,* 13 : 1911, No. 5.

Report of a study in the standardization of a number of association tests. Tests are described and critically discussed.